Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

JANUARY 1954

VOLUME 37 · NUMBER 1

Electron microphotograph (x50,000) of Pexol size precipitate on bleached sulfite paper

TAKE A CLOSE LOOK AT PEXOL*

This photometer, developed by Hercules, measures the penetration time of liquids through sheets sized with Pexol.

Laboratory microphotographs of Pexol are required to demonstrate the physical structure of this fortified size. But no enlargement of the facts is needed to prove what this *properly balanced* fortified size offers in use.

Mills using paste or dry Pexol report substantial reductions in size furnish. Sizing tests maintained . . . often improved! Inventories reduced! Freight and handling costs cut!

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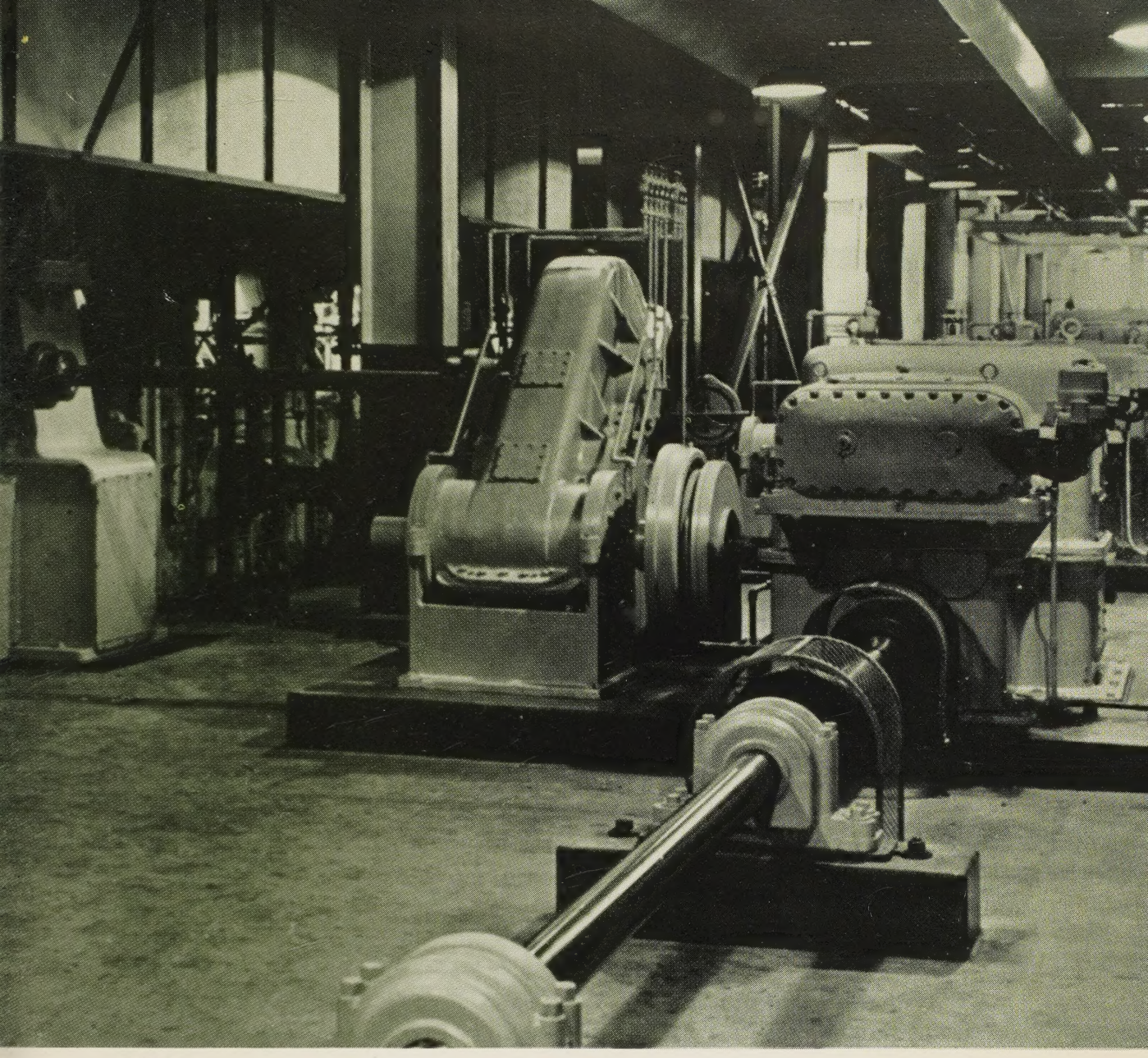

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No belts to slip or motors to vary under changing power demands. Gears are of standard types, for simplified maintenance. Extremely exact adjustment of draws makes possible minimum strain on the sheet, thus reducing shrinkage in width, raising sheet tests, and sharply cutting machine breaks.—*Beloit Iron Works, Beloit, Wis.*

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for the Weyerhaeuser Timber Company

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THE above view shows one of the two 11 ft. diameter by 30 ft. $1^1/_2$ in. stainless clad steel digesters which we built for the Weyerhaeuser Timber Company's plant at Springfield, Oregon, in 1950. Clad digesters have the stainless material rolled together with carbon steel plates as opposed to lined digesters wherein the lining is attached by welding.

Built in accordance with the 1950 ASME Code for Unfired Pressure Vessels, the two digesters were designed for a working pressure of 110 lbs. per sq. in. at a maximum temperature of 650 degrees Fahrenheit. They were given a hydrostatic test at 187 lbs. per sq. in.

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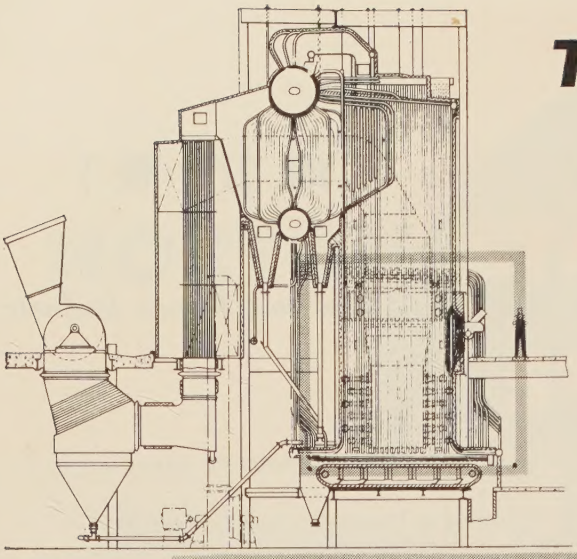

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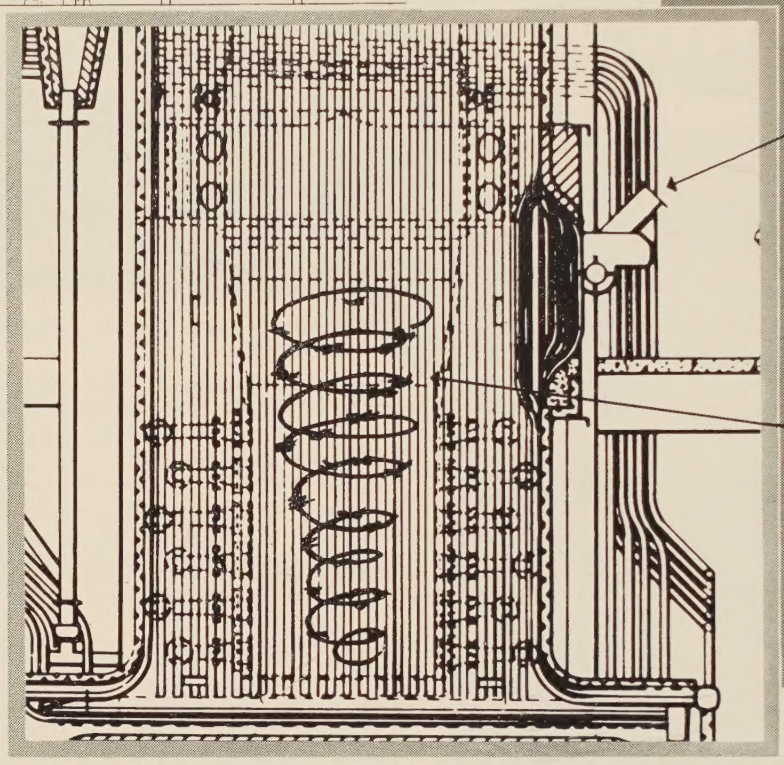

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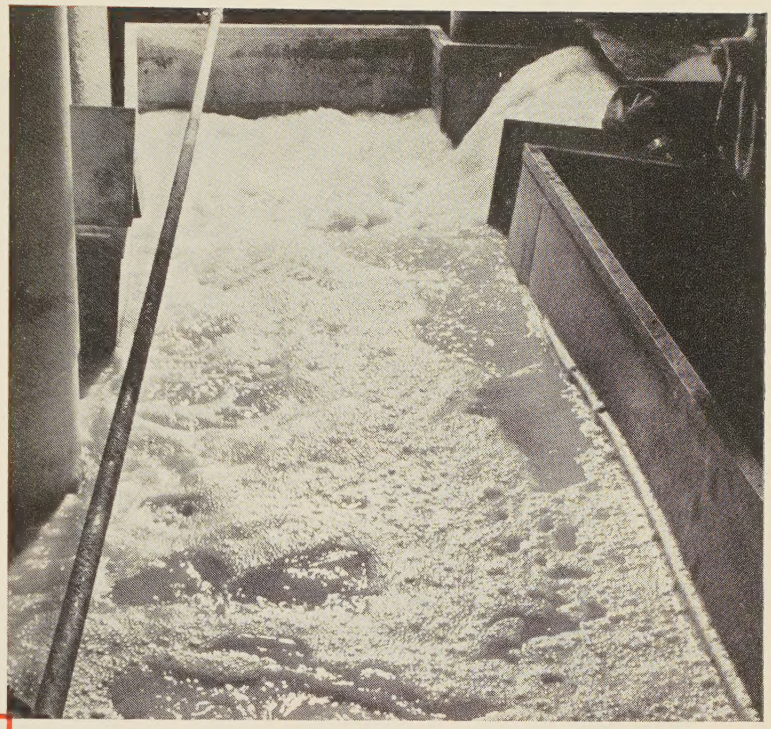
FOAM SPOTS IN THE PAPER

FOAM AT THE SEAL BOX

FOAM AT THE SAVE-ALL

FOAM IN THE VATS



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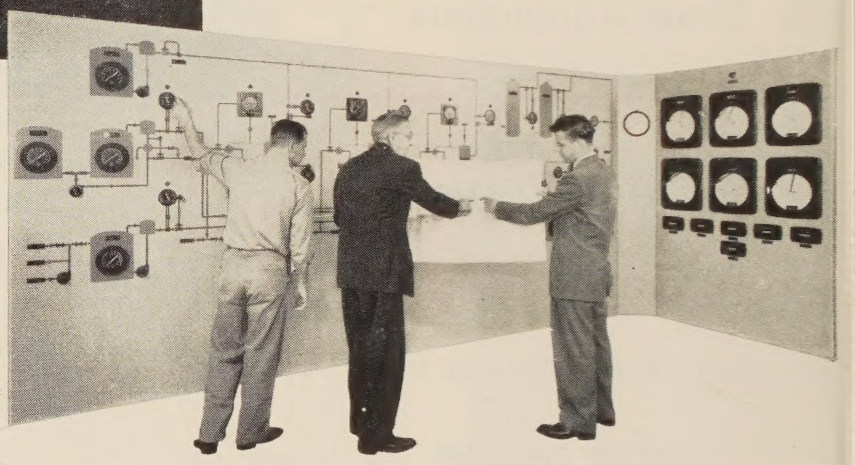

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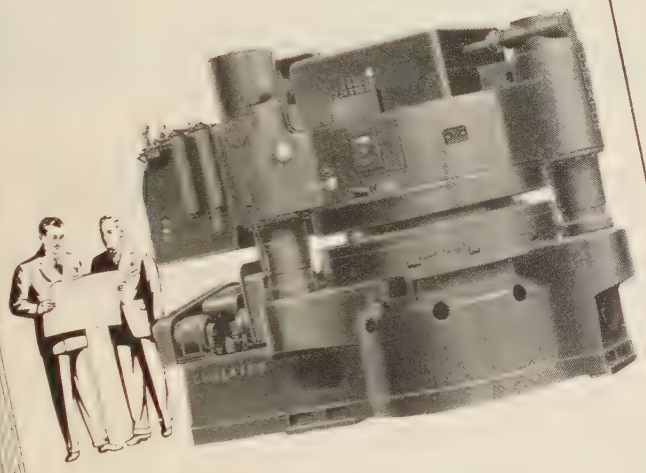

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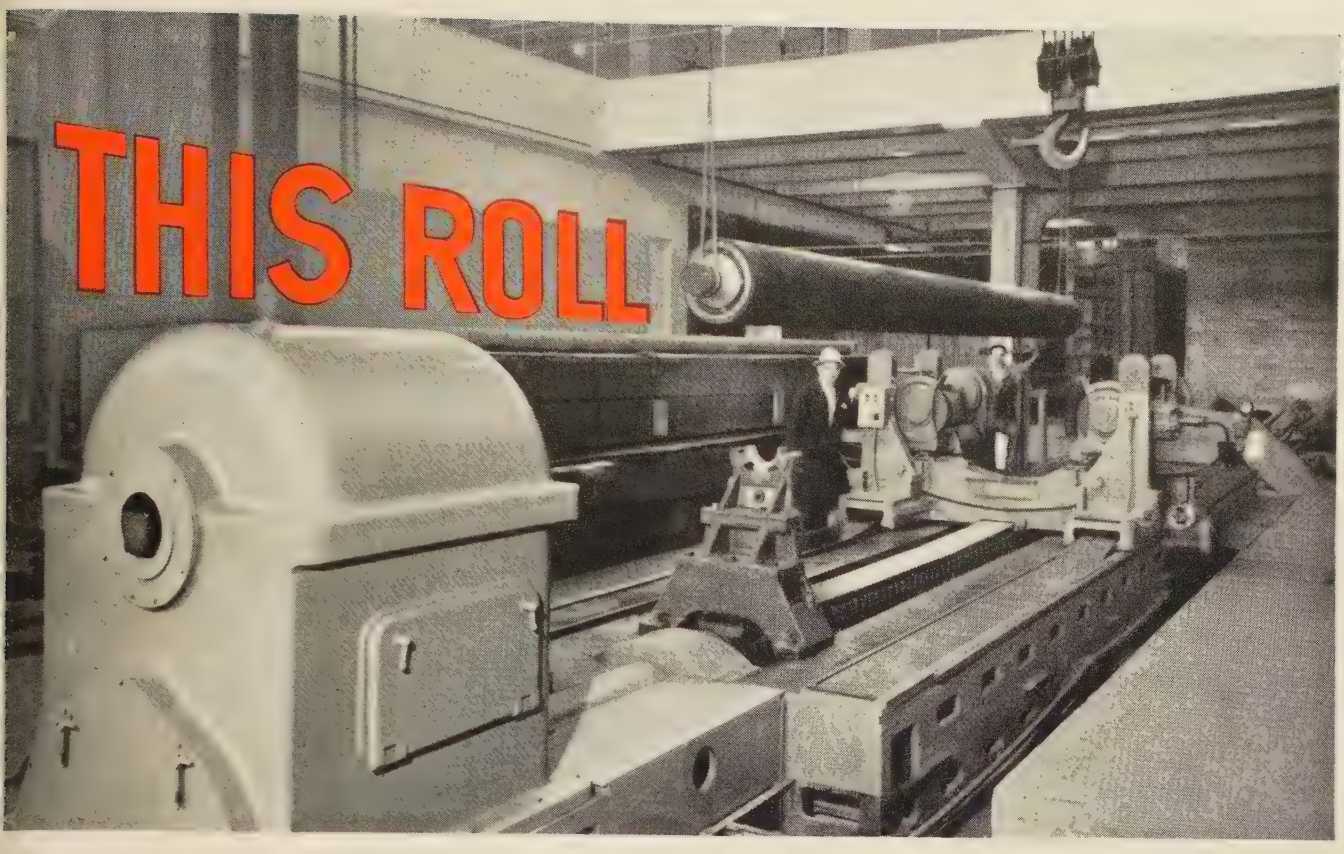

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TAPPI Annual Meeting Program

Commodore Hotel, New York, N. Y., Feb. 15–18, 1954

TAPPI 39th Annual Meeting

The 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry will be held at the Commodore Hotel, New York, N. Y., on Feb. 15–18, 1954.

Members of the Association should remember to bring their 1954 membership cards with them since the lower registration fee will be limited to individuals who can present their 1954 cards. All individuals attending the Annual Meeting must register.

MONDAY, FEBRUARY 15, 1954

10:00 a.m. First General Session (East Ball Room)

G. H. PRINGLE, President of TAPPI, Mead Corp., Chillicothe, Ohio, *Chairman*

1. Secretary's Report, by R. G. Macdonald.
2. President's Address, by George H. Pringle.
3. Report of the Tellers Committee.
4. Report of the Joint Textbook Committee, by R. S. Kellogg, *Secretary*.
5. "The Paper Industry in the Far East," by Roland A. Packard, Washington, D. C.
6. "Fiberglas as a Papermaking Material," by Thomas S. Chambers, Owens-Corning Fiberglas Co., Newark, Ohio.
7. "Manufacture of Board Continuously by a Dry Process," by R. S. Aries, Aries Fireboard Corp., New York, N. Y.
8. "A Laboratory to Coordinate Science and Manufacturing Operations," by Reavis C. Sproul, Herty Foundation, Savannah, Ga. (by title).

10:30 a.m. Wax Testing (Room C)

Section I, Strength Tests, J. W. PADGETT, *Chairman*

10:00 a.m. Packaging Materials Testing Committee (Room F)

2:00 p.m. Committee Meetings (Grand Ball Room)

All committee meetings will be held in the Grand Ball Room unless otherwise indicated.

Tables assigned to committees will be designated by table cards.

Research Development Division (Grand Ball Room)

W. F. HOLZER, Crown Zellerbach Corp., San Francisco, Calif., *General Chairman*

- Statistics Committee—JOHN F. LANGMAID, JR., *Chairman*, S. D. Warren Co., Cumberland Mills, Me.
- Microbiological Committee—B. F. SHEMA, *Chairman*, Institute of Paper Chemistry, Appleton, Wis. (Room G, Wed.)
- Fundamental Research Committee—H. F. LEWIS, *Chairman*, Institute of Paper Chemistry, Appleton, Wis. (Room 825)

Industrial Division (Grand Ball Room)

N. I. BEARSE, Champion-International Co., Lawrence, Mass., *General Chairman*

- Nonfibrous Raw Materials Committee—E. N. POOR, Hudson Pulp & Paper Co., Augusta, Me., *Chairman*
- Water Committee—A. S. ERSPAMER, St. Helens Pulp & Paper Co., Division, Crown Zellerbach Corp., St. Helens, Ore., *Chairman*
- Fibrous Agricultural Residues Committee—S. I. ARONOVSKY, Northern Regional Research Laboratory, Peoria, Ill., *Chairman*
- Structural Fibrous Materials Committee—E. M. JENKINS, Johns-Manville Research Center, Manville, N. J. *Chairman* (Room G, Tues., 2:00 p.m.)

Converting and Consuming Division (East Ball Room)

L. K. BURNETT, Ohio Boxboard Co., Rittman, Ohio, *General Chairman*

- Graphic Arts—C. A. MORTON, West Virginia Pulp & Paper Co., Chicago, Ill., *Chairman*
- Coating Committee—R. T. TRELFA, Watervliet Paper Co., Watervliet, Mich., *Chairman*
- Wet Strength Committee—K. W. BRITT, Scott Paper Co., Chester, Pa., *Chairman*
- Plastics Committee—R. T. NAZZARO, Westfield River Paper Co., Russell, Mass., *Chairman*
- Corrugated Containers Committee—BURT MENDLIN, Cornell Paperboard Products, Milwaukee, Wis., *Chairman*

Pulp Manufacture Division (Grand Ball Room)

G. A. DAY, Brown Co., Berlin, N. H., *General Chairman*

- Alkaline Pulping Committee—FRED W. BISHOP, *Chairman*, Southland Paper Mills, Lufkin, Tex. (Room G)
- Mechanical Pulping Committee—F. W. O'NEIL, College of Forestry, State University of New York, Syracuse, N. Y., *Chairman*
- Chemical Products Committee—ARTHUR POLLAK, Consulting Engineer, New York, N. Y., *Chairman*
- Pulp Purification Committee—H. HOWARD RAPSON, University of Toronto, Toronto, Ont., *Chairman*
- Acid Pulping Committee—E. H. WOODRUFF, Rayonier Inc., Port Angeles, Wash., *Chairman*
- Semichemical Pulping Committee—J. N. MCGOVERN, Forest Products Laboratory, Madison, Wis., *Chairman*
- Paper Deinking Committee—J. J. FORSYTHE, International Paper Co., Niagara Falls, N. Y., *Chairman*
- Pulp for Chemical Conversion—F. A. SIMMONDS, Forest Products Laboratory, Madison Wis., *Chairman*

Paper Manufacture Division (Grand Ball Room)

R. P. PRICE, Hammermill Paper Co., Erie, Pa., *General Chairman*

- Preparation of Papermaking Materials Committee—F. S. KLEIN, Byron Weston Co., Dalton, Mass., *Chairman*
- Papermaking (Cylinder) Committee—GLEN RENEGAR, Container Corp. of America, Manayunk, Pa., *Chairman* (Room E)
- Papermaking (Fourdrinier) Committee—N. R. PHILLIPS, Champion Paper & Fibre Co., Canton, N. C., *Chairman* (Room F)

Testing Division (West Ball Room)

J. P. CASEY, A. E. Staley Mfg. Co., Decatur, Ill., *General Chairman*

- Nonfibrous Materials Testing Committee—JAMES R. LYON, Atlas Boxmakers, Inc., Chicago, Ill.
- Pulp Testing Committee—F. E. CASKEY, Crown Zellerbach Corp., Camas, Wash., *Chairman*
- Optical Properties Committee—H. E. OBERMANNS, Hammermill Paper Co., Erie, Pa., *Chairman*
- Microscopy Committee—C. E. BRANDON, Howard Paper Mills, Dayton, Ohio, *Chairman*
- Paper Testing Committee—D. H. NEWCOMB, Riegel Paper Corp., Hughesville, N. J., *Chairman*
- Packaging Materials Testing Committee—W. H. AIKEN, Gardner Board & Carton Co., Middletown, Ohio, *Chairman* (Room F 10:00 a.m.)
- Chemical Methods—A. S. O'BRIEN, Eastman Kodak Co., Rochester, N. Y., *Chairman*
- Wax Testing—W. J. YATES, Shell Oil Co., New York, N. Y., *Secretary*. (Section II, Flow Tests, and Section III, Stability Tests) (Room C)

Note: Reports by all committee chairmen of the Testing Division will be given at this session.

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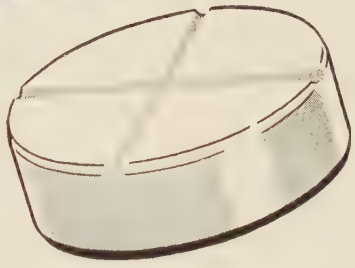

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Engineering Division (Room A)

C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y., *General Chairman*

Steam and Power Committee—W. M. Wyburn, Federal Paper Board Co., Bogota, N. J., *Chairman*
Materials Handling Committee—W. R. McNally, Link-Belt Co., Chicago, Ill., *Chairman*
Chemical Engineering Committee—J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga., *Chairman*
Digester Corrosion Subcommittee—N. Shoumatoff, West Virginia Pulp & Paper Co., New York, N. Y., *Chairman*
Mill Maintenance Materials Committee—G. F. Hrubecky, Marathon Corp., Menasha, Wis., *Chairman*
Mill Planning and Economics Committee—R. A. Packard, Washington, D. C., *Chairman*
Engineering Research and Machine Design Committee—R. G. Quinn, Johns-Manville Corp., Manville, N. J., *Chairman*
Electrical Engineering Committee—R. W. Foster, Champion Paper & Fibre Co., Canton N. C., *Chairman*
Data Sheets Committee—J. W. Hemphill, Johns-Manville Corp., New York, N. Y., *Chairman*
Drying and Ventilating Committee—C. A. Young, Riegel Paper Corp., Milford, N. J., *Chairman*

TUESDAY, FEBRUARY 16, 1954

9:15 a.m. Corrugated Containers (Grand Ball Room)

Charles E. Jakeway, American Box Board Co., Grand Rapids, Mich., *Chairman*

Symposium—"The Easy Opening Box"

1. "Application of Gummed Tear Tape on the Semiautomatic Taping Machine," by Foster Lowery, Universal Corrugated Box Machinery Co., Linden, N. J.
2. "Pressure Sensitive Tear Tape and Its Application to the Weber Machine," by E. L. Decker, Minnesota Mining & Mfg. Co., St. Paul, Minn.
3. Paper by Walter Friedman, General Gummed Products Co., Richmond Hill, N. Y.

9:15 a.m. Digester Corrosion (East Ball Room)

N. Shoumatoff, West Virginia Pulp & Paper Co., *Chairman*

1. "The History of Carbon Brick Linings in Alkaline Pulping Digesters," by Beaumont Thomas, Stebbins Engineering & Mfg. Co., Watertown, N. Y.
2. "A Laboratory Approach to the Study of Digester Corrosion," by J. W. Hassler, West Virginia Pulp & Paper Co., Tyrone, Pa.
3. "Experiments with Digester Corrosion Variables," by E. W. Hopper and J. M. Morrison, Crucible Steel Co. of America, Pittsburgh, Pa.
4. "Field Investigation of Corrosion in Alkaline Pulping Equipment," by C. B. Christianson, Pulp and Paper Research Institute of Canada, Montreal, P. Q.
5. "Bibliography on Alkaline Digester-Corrosion," by R. P. Whitney, Institute of Paper Chemistry, Appleton, Wis., and S. J. Baisch, Thilmany Pulp & Paper Co., Kaukauna, Wis. (by title).

9:15 a.m. Wax Testing (Room A)

Section IV, Sensory Tests, G. D. Fronmuller, *Chairman*
Section VIII, Scuff and Gloss, G. P. Mueller, *Chairman*

9:15 a.m. Papermaking (Fourdrinier) (Room B-C)

N. R. Phillips, Champion Paper & Fibre Co., *Chairman*

1. "Weight Profile Measurement of Paper and Machine Clothing with the Tracerlab Beta Ray Scanner," by James D. Sadtler and H. Borofsky, Southland Paper Mills, Lufkin, Tex.
2. "Beta Gauge Basis Weight Control," by Fred W. Rauskolb, Industrial Nucleonics Corp., Columbus, Ohio.
3. "Load Meters, Tension Meters and Torque Meters for Paper Machines," by John C. Harper and T. A. McArn, Downington Mfg. Co., Downington, Pa.
4. "An Experimental Study of the Factors Involved in the Manufacture of Paper Yarn," by Geoffrey Broughton, University of Rochester, Rochester, N. Y., and James P. Wang, Lowell Technological Institute, Lowell, Mass.
5. "The Mechanical Properties of Paper," by Geoffrey Broughton and James P. Wang (by title).

9:15 a.m. Structural Fibrous Materials (South Room)

E. M. Jenkins, Johns-Manville Research Center, *Chairman*

1. "The Importance of Speed of Test on Bending Strength Properties of Insulating Board," by Wayne C. Lewis, Forest Products Laboratory, Madison, Wis.
2. "Evaluation of the TAPPI-SFMC Drainage Time Tester for Mill Control of Insulating Board Pulps," by W. H. Graham, Johns-Manville Products Corp., Natchez, Miss.
3. "A Comparison of the TAPPI-SFMC Drainage Time Test Procedure with Olin Methods," by D. R. P. Haig, Johns-Manville Research Center, Manville, N. J.
4. "Evaluation of the TAPPI-SFMC Drainage Time Tester of TAPPI T 1002 sm-51," by Jules J. Perot, Flintkote Co., Whippany, N. J., and C. E. Hrubesky, Forest Products Laboratory, Madison, Wis.
5. Panel Discussion: J. J. Perot, Moderator, Thure Duval, Wood Conversion Co., Cloquet, Minn., C. E. Hrubesky, and D. R. P. Haig.

9:15 a.m. Papermaking (Cylinder) (West Ball Room)

Glen Renegar, Container Corp. of America, *Chairman*

1. "Smoothness of Paperboard" (a symposium).
   (a) "Scope of the Problem," by G. T. Renegar.
   (b) "End Use Requirements and Testing for Smoothness," by A. T. Luey, Sutherland Paper Co., Kalamazoo, Mich.
   (c) "Finishing and Drying," by K. M. Winrich, Cornell Paperboard Products Co., Cornell, Wis., and Peter Smith, Continental Paper Co., Ridgefield Park, N. J.

2:00 p.m. Papermaking (Cylinder) (West Ball Room)

1. "Smoothness of Paperboard" (*continued*).
   (d) "Wet End Aspects," by G. C. Ehemann, Ohio Boxboard Co., Rittman, Ohio.
   (e) "Stock Preparation," by E. F. Manogue, Gibraltar Corrugated Paper Co., North Bergen, N. J.
   (f) "Raw Materials Problems," by A. E. Bachmann, Missisquoi Corp., Sheldon Springs, Vt.

2:00 p.m. Structural Fibrous Materials (Room G)

Committee Meeting

2:00 p.m. Acid Pulping (Room B-C)

E. H. Woodruff, Rayonier Inc., *Chairman*

1. "The Resistance of Douglas-Fir to Sulphite Pulping," by William H. Hoge, Oxford Paper Co., Rumford, Me.
2. Panel on Acid Pulping—G. H. McGregor, Minnesota & Ontario Paper Co., International Falls, Minn., Moderator.
   (a) "Acid Sulphite Pulping with Bases Other Than Calcium," by R. S. Hatch, Hudson Pulp & Paper Co., Palatka, Fla.
   (b) "Acid Sulphite Pulping of Other Than Normal Species, Such as Highly Resinous Woods and Deciduous Woods," by G. H. McGregor.
   (c) "High Yield Acid Sulphite Pulping," by L. R. Beath, Price Bros. & Co. Ltd., Riverbend, P. Q.
   (d) "Sulphite Pulping and as Related to Stream Problems in Eastern U.S.A.," by V. P. Edwardes, Corinth, N. Y.
   (e) "Sulphite Pulping and Stream Problems in the Pacific Northwest," by H. R. Amberg, National Council for Stream Improvement, Corvallis, Ore.
   (f) "Sulphite Pulping and Stream Problems in the Midwest," by N. L. Malcove, Northern Paper Mills, Green Bay, Wis.

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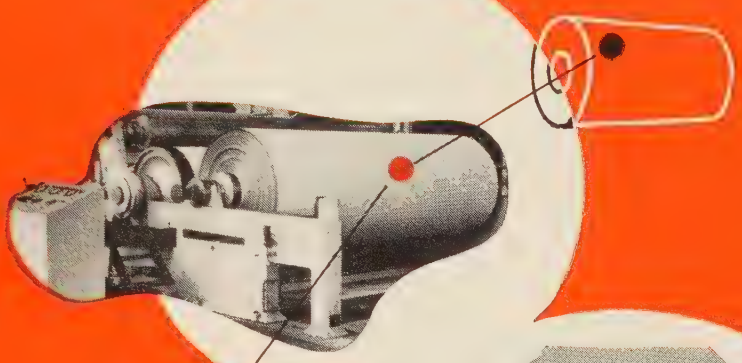

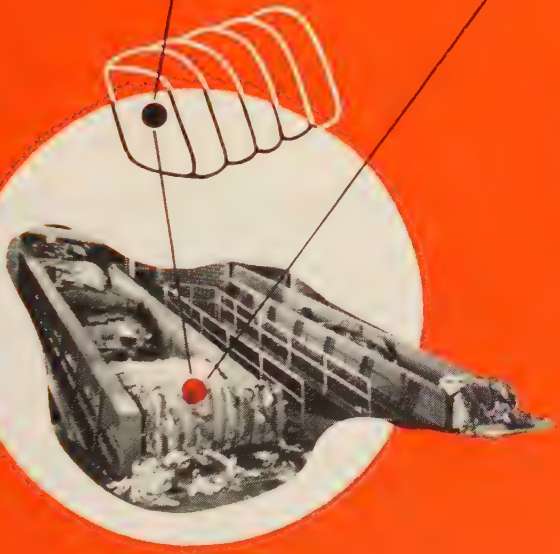

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3. "Vapor-Liquid Equilibria in the System NH_3–SO_2–H_2O," by D. T. Hayden, A. L. Babb and Joseph L. McCarthy, University of Washington, Seattle 5, Wash.

2:00 p.m. Corrugated Containers (Grand Ball Room)

JOSEPH J. KOENIG, Gaylord Container Corp., St Louis, Mo., *Chairman*

Symposium—"High Humidity Containers"

1. "Requirements of Packages in the Cheese Industry," by L. J. Hayhurst, Kraft Foods Co., Glenview, Ill.
2. "Corrugated Adhesives for Use with High Humidity Containers Such as Those with Sulphur Impregnated Corrugating Medium," by Claude H. Fletcher, Corn Products Sales Co., Kalamazoo, Mich.
3. "Case Sealing Adhesives for High Humidity Container Storage," by W. Sederlund, National Starch Products, Inc., New York, N. Y.
4. "Laboratory Evaluation Procedures and Field Tests on High Humidity Containers," by C. J. Zusi, Container Laboratories, Chicago, Ill.
5. Panel—"Operating Problems and Field Experience with High Humidity Containers"—led by D. Shepard, Jr., Menasha Wooden Ware Corp., Menasha, Wis.

2:00 p.m. Papermaking (Fourdrinier) (East Ball Room)

N. R. PHILLIPS, *Chairman*

1. "An Investigation of Methods for Dimensionally Stabilizing Paper," by Frank Lorey, Mead Corp., Chillicothe, Ohio.
2. "Consistency Regulator Installations," by David Dezurik, Dezurik Shower Co., Sartell, Minn.
3. "The Coordinate Role of Alum in the Sizing of Paper," by R. M. Karapetoff Cobb and D. V. Lowe, Lowe Paper Co., Ridgefield, N. J.
4. "Effects of Mechanical Preparation and pH on the Strength of Glass-Fiber Paper," by M. J. O'Leary, R. B. Hobbs, J. K. Missimer, and J. J. Erving, National Bureau of Standards, Washington, D. C.
5. "Studies of Rosin Sizing by Means of Autoradiography and Electron Microscopy," by Charles W. Hook, Hercules Powder Co., Wilmington, Del.
6. Film—"Weaving Wisconsin Wires," by James E. Watson, Wisconsin Wire Works, Appleton, Wis.

2:00 p.m. Wax Testing (Room A)

Section V, Composition, J. B. RATHER, *Chairman*
Section VI, Blocking, H. F. HITCHCOX, *Chairman*

WEDNESDAY, FEBRUARY 17, 1954

9:15 a.m. Corrugated Containers (Grand Ball Room)

D. P. MCNELLY, Fort Wayne Corrugated Paper Co., Rochester, N. Y., *Chairman*

Symposium—"Heat Balance and Its Effect on Corrugated Board"

1. "Steam System on Combiners," by Paul Harrison, Velocity Steam Production Engineering, Chicago, Ill.
2. "The Hot Oil System," by R. Casper, Swaney Mountain State Fabricating Co.
3. "Detrimental Effect of Either Excessive Heat or Insufficient Heat on Corrugated Starch Bond," by C. R. Vander Meulin, Penick & Ford, Inc., Cedar Rapids, Iowa.
4. "The Conventional Trap Steam System," by Charles Nitchie, Samuel M. Langston Co., Camden, N. J.
5. "The Cochrane C. D. System," by R. J. Lundrigan, Cochrane Corp., Philadelphia, Pa.

9:15 a.m. Papermaking (Cylinder) (West Ball Room)

GLEN T. RENEGAR, *Chairman*

1. Review of symposium on "Smoothness of Paperboard," by Glen T. Renegar.

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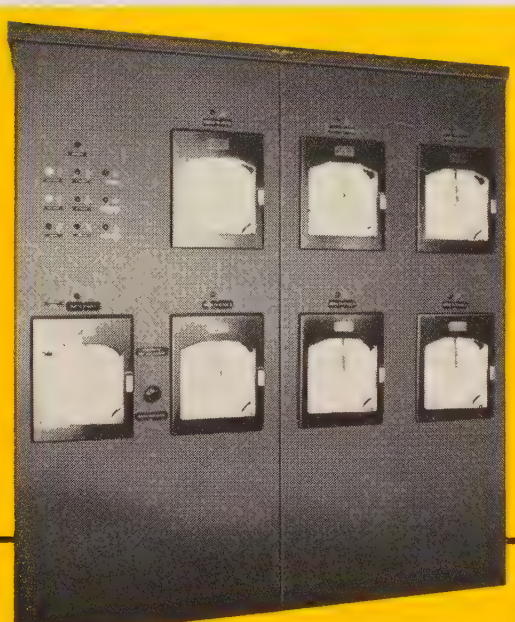

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9:15 a.m. Pulp Purification (East Ball Room)

W. Howard Rapson, Universiy of Toronto, *Chairman*

1. "A New Process for the Bleaching of Chemical Pulps, Especially Kraft, with Peroxide," by W. F. Schroeder, National Distillers Chemical Corp., Ashtabula, Ohio.
2. "Bleaching with Chlorine Dioxide," by W. D. Harrison, Riegel Paper Corp., Milford, N. J.
3. "Chromatographic Techniques in the Analysis of Purified Pulps," by J. F. Saeman, W. E. Moore, and R. L. Mitchell, Forest Products Laboratory, Madison, Wis.
4. "A Comparison of Processes for Manufacturing Chlorine Dioxide in Pulp Mills," by W. Howard Rapson.

9:15 a.m. Statistics (Room B-C)

John F. Langmaid, Jr., S. D. Warren Co., Cumberland Mills, Me., *Chairman*

1. "The Simultaneous Process Control of Two Tests," by Geofirey Beall, University of Connecticut, Storrs, Conn., jointly with Truman A. Pascoe, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
2. "Some Examples of Designed Experiments in Industry," by Charles A. Bicking, Research & Development Div., Office of the Chief of Ordnance, Washington, D. C.
3. "Quality Control in Envelope Manufacture," by J. Rex Adams, Old Colony Envelope Co., Westfield, Mass.
4. "A Multiple Correlation Ranking Method," by T. H. Geiger, Oxford Paper Co., Rumford, Me.
5. "Determining Capability, Control and Achievement in the Paperboard Industry," by Paul C. Clifford, Consultant on Quality Control, Montclair, N. J.

9:15 a.m. Wax Testing (Room A)

Section VII, Sealing and Laminating, G. C. Borden, Jr., *Chairman*

9:15 a.m. Paper Testing and Microscopy (Room F)

2:00 p.m. Testing (South Room)

A. S. O'Brien, Eastman Kodak Co., *Chairman*

1. "The Effect of Copper and Base Concentrations in Cellulose Solvents," by B. L. Browning, Institute of Paper Chemistry, Appleton, Wis.
2. "Prediction of Brightness of Groundwood-Sulphite Mixtures," by D. J. MacLaurin, Institute of Paper Chemistry, Appleton, Wis., and F. A. Aflenzer, Institute of Pulp and Paper Technology, Graz, Austria.
3. "Methods for Cellulose Accessibility Determination," by Geoffrey Broughton, E. Heekgaret, and Conrad Johannes, University of Rochester, Rochester, N. Y.
4. "Photometric Determination of the Solubility of Pulp in Sodium Hydroxide Solutions," by Ralph M. Kingsbury, Forest Products Laboratory, Madison, Wis.
5. "How Retention and Wet Strength are Related to the Cationic Character of Urea-Formaldehyde Wet-Strength Resins," by J. Vernon Kindall, Plaskon Div., Libbey-Owens-Ford Co., Toledo, Ohio.

2:00 p.m. Corrugated Containers (Grand Ball Room)

1. General Technical Session (speakers to be announced).

2:00 p.m. Statistics (Room B-C)

John F. Langmaid, Jr., *Chairman*

1. "Quality Control Rates Raw Material Suppliers," by W. A. MacCrehan, Jr., Bendix Radio Div., Bendix Aviation Corp., Baltimore, Md.
2. "Estimating Variance Components in Processing a Paper Roll," by Geoffrey Broughton and S. Lee Crump, University of Rochester, Rochester, N. Y.
3. "Control Chart for Newsprint Web Breaks," by Sol Steinberg, New York *Times*, New York, N. Y.
4. "Some Interesting Mill Problems Solved," by Leonard Marasculio and Truman A. Pascoe. Nekoosa-Edwards Paper Co., Port Edwards, Wis.
5. "Quality Control in Containers Processing," by Warren Purcell, Rath & Strong, Industrial Consultants, Boston, Mass.
6. "A Study of Basis Weight and Caliper Variation," by Maynard S. Renner, Dewey and Almy Chemical Co., Cambridge, Mass.

2:00 p.m. Chemical Engineering (West Ball Room)

J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.,

1. "Corrosion Problems in Bleach Plants Using Chlorine Dioxide," by H. O. Teeple, International Nickel Co., New York. N. Y.
2. "The Correlation of Evaporation and Brown Stock Washing," by W. G. Detert and R. E. Bergstrom, Swenson Evaporator Co., Harvey, Ill.
3. "Some Aspects of Permeation, Filtration, and Fluidization," by Roy P. Whitney, W. L. Ingmanson, and S. T. Han, Institute of Paper Chemistry, Appleton, Wis.

2:00 p.m. Semichemical Pulping (East Ball Room)

J. N. McGovern, Forest Products Laboratory, Madison, Wis., *Chairman*

1. "Effect of Cooking Conditions in Neutral Sulphite Pulping of Sweetgum," by J. J. Owen, Jr., E. J. McCue, and R. R. Chase, Union Bag & Paper Corp., Savannah, Ga.
2. "An Orienting Study of the Effect of the Neutral Sulphite Semichemical Cook on the Hemicelluloses of Aspenwood," by David C. Lea, Potlatch Forests, Inc., Lewiston, Idaho.

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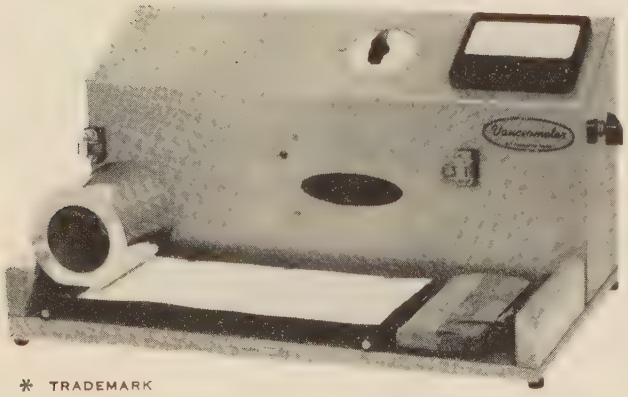

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3. "Report of Subcommittee on Semichemical Pulping Equipment Survey," by J. E. Sapp, Gaylord Container Corp., Bogalusa, La.
4. "Properties of Semichemical Pulps," by E. H. Shriver, Mead Corp., Chillicothe, Ohio.

2:00 p.m. Tissue Subcommittee (Room F)

THURSDAY, FEBRUARY 18, 1954

9:00 a.m. Pulps for Chemical Conversion (Room A)

FORREST A. SIMMONDS, Forest Products Laboratory, Madison, Wis., *Chairman*

1. "Problems in the Evaluation of the Caustic Absorbency of Pulp Sheets," by R. W. Swinehart and A. T. Maasberg, Dow Chemical Co., Midland, Mich.
2. "A Cellulose Yield Test Overcoming the Inadequacies of the Alpha Test," by Frank R. Charles, Industrial Cellulose Research Ltd., Hawkesbury, Ont.
3. "Viscose Filter Number Evaluation of Cellulose Pulps," by E. L. Hanson and L. M. Cook, The Visking Corp., Chicago, Ill.
4. "Investigation of the Haze in Cellulose Acetates Made from Wood Pulps," by Keith E. Bradway, Camp Mfg. Co., Franklin, Va.
5. "Effect of Medium in the Acetylation of Cellulose," by R. C. Blume and F. H. Swezey, E. I. du Pont de Nemours & Co., Waynesboro, Va.
6. "Carbohydrates in Woods and Pulps by Chromatographic Analysis," by Albert Z. Conner, Hercules Powder Co., Wilmington, Del.
7. "Purified Hardwood Pulps for Chemical Conversion. II. Prehydrolysis-Sulphate Pulps from Sweetgum," by F. A. Simmonds, J. S. Martin, and R. M. Kingsbury, Forest Products Laboratory, Madison, Wis.

9:00 a.m. Water (West Ball Room)

A. S. ERSPAMER, Hollingsworth & Whitney Co., Waterville, Me., *Chairman*

1. "Condensate Corrosion—Its Causes and Prevention," by Seldon K. Adkins and Maurice F. Nielsen, National Aluminate Co., Chicago, Ill.
2. "The Continuous Preparation and Application of Silica Sols in the Paper Industry," by L. L. Klinger, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
3. "The Accelerated Biological Oxidation of Kraft Mill Effluents," by Fred W. Bishop, Southland Paper Mills, Lufkin, Tex.
4. "The Aerobic and Benthal Oxygen Demand of Paper Mill Waste Deposits," by Nicholas Lardieri, National Council for Stream Improvement, New York, N. Y.
5. "Stream Pollutional Aspects of Mill Antiseptics," by W. M. Van Horn, Institute of Paper Chemistry, Appleton, Wis.
6. "The Biological Inactivation of Mercurials by Pulps," by B. F. Shema, Institute of Paper Chemistry, Appleton, Wis.

9:00 a.m. Alkaline Pulping (Room B-C)

FRED W. BISHOP, Southland Paper Mills, *Chairman*, and B. F. SHEMA, Institute of Paper Chemistry, *Chairman*

1. "The Effect of Alkaline Pulping on the Lignin of *Eucalyptus regnans*," by J. W. T. Merewether, Australian Paper Manufacturers, Ltd., Melbourne, Australia.
2. "Lime Sludge Recovery in the Pulp Industry," by W. Tock, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
3. "A Theoretical Treatment of Liquor Handling in Continuous Pulping," by W. J. Nolan, University of Florida, Gainesville, Fla.
4. "The Use of the Peabody Scrubber on Lime Kiln Stack Gases," by Paul Mockridge, Peabody Eng. Corp., New York, N. Y.
5. "The Effect of Bark in the Sulphate Pulping of Northern Oak Mixture," by K. I. Brown, Forest Products Laboratory, Madison, Wis.
6. "Screening of Sulphate Pulp," by Doyle Dykes, Macon Kraft Co., Macon, Ga.

12:45 p.m. Testing (South Room)

JAMES D'A. CLARK, Consultant, Longview, Wash., *Chairman*

1. "The Interrelation of Fiber Length Distribution, Fiber Length Index, and Physical Characteristics of Hand Sheets," by A. H. Nadelman, R. Schmut, D. J. Kraske, and R. I. Larson, Western Michigan College, Kalamazoo, Mich.
2. "The Measurement of Wet Web Strength," by L. M. Lyne and W. Gallay, E. B. Eddy Co., Hull, P. Q.
3. "Studies in the Fundamentals of Wet Web Strength," by L. M. Lyne, and W. Gallay.
4. "The Development and Use of the Chapman Printing Smoothness Tester," by S. M. Chapman, Pulp and Paper Research Institute of Canada, G. R. Sears, Institute of Paper Chemistry, and D. N. Obenshain, West Virginia Pulp & Paper Co.
5. "Development of Method for Measuring the Gloss of Very Glossy Paperboard," by R. S. Hunter, Hunter Associates Laboratory, Falls Church, Va.
6. "A Study of the Effects of Instrumental Variables on 75° Specular Gloss," by L. W. Zabel, Kimberly-Clark Corp., Neenah, Wis., and W. A. Wink, Institute of Paper Chemistry, Appleton, Wis.

12:45 p.m. Annual Luncheon (Grand Ball Room)

GEORGE H. PRINGLE, *Presiding*

1. Address by George Olmsted, Jr., President of S. D. Warren Co., Cumberland Mills, Me.
2. Presentation of the TAPPI Medal to Gunnar W. E. Nicholson, Union Bag & Paper Corp., New York, N. Y., by K. O. Elderkin, Bowaters Southern Paper Corp., Calhoun, Tenn.

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2063

OUTLOOK FOR THE UNITED STATES PAPER INDUSTRY IN 1954

LOUIS T. STEVENSON

FOREWORD

We present herewith another of our continuing discussions of the paper industry, which we are undertaking to keep under constant observation.

Our clients are aware that early this year we retained Dr. Louis T. Stevenson, until then Economist for the American Paper & Pulp Association and widely acquainted in the paper industry, to direct our efforts in the field.

In this current analysis, Dr. Stevenson examines the current relationships between capacity and demand for the various segments of the industry and draws certain conclusions with regard to the outlook for next year.

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DURING the first part of World War II, the pulp and paper industry was listed as "nonessential" by the War Production Board and its vital necessity to the war effort was only discovered by them when the war was half over. Then a sudden and major backtrack was necessary. The National Production Authority avoided that pitfall and put pulp and paper in the essential list, at the outset of the Korean crisis. Many Certificates of Necessity were granted to firms in and out of the paper industry to increase paper and pulpmaking capacity. A program for industry capacity to be reached by 1955 was set up by National Production Authority. Targets of capacities to be reached by that date were, after delay and considerable dispute between the industry advisory committee and National Production Authority staff, adopted for most of the major grades of paper and pulp.

Practically all of these programs excepting that for newsprint capacity in the United States have been implemented by construction either already completed or now under way. Newsprint capacity after falling to the very low level of 823,000 tons annually in 1947 is scheduled for a 59% increase from that level by 1954. That still does not satisfy the National Production Authority program which obviously was designed to lessen the present United States dependence upon Canadian newsprint which now supplies about 80% of United States consumption.

The reasonableness of the National Production Authority program will not be discussed herein. It is mentioned only as one of the contributing reasons for the present situation. Almost every industry in the United States was affected by the Certificates of Necessity programs set up by the National Production Authority and the Defense Production Administration.

LOUIS T. STEVENSON, Economist, Tucker, Anthony & Co., New York, N. Y.

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The paper industry was so organized through its trade associations as to be able to cooperate with the Washington authorities to keep the program fairly close to the realities of the situation.

However, most all of that is history and we must now face the present and the future. The present problems are: What is the present capacity? How much of it is employed? How much more will be added by Jan. 1, 1955? What are the probabilities for the employment of the 1954 capacity next year? These are questions to which answers are needed.

PRESENT CAPACITIES AND PRODUCTION RATIOS

Present papermaking capacity divides itself roughly at 13½ million tons of paper and 15 million tons of board annually. The following breakdown gives the detail for the year 1953 in thousands of tons annually.

	Annual capacity[a] (1000 tons)
Paper	
Book and ground wood	3,577
Fine	1,365
Wrapping and specialty	4,421
Tissue	1,464
Absorbent	118
Newsprint	1,093
Building paper	1,389
Total paper	13,427
Board	
Building board	1,560
Paperboard	13,561
Total board	15,121
Total paper and board	28,548

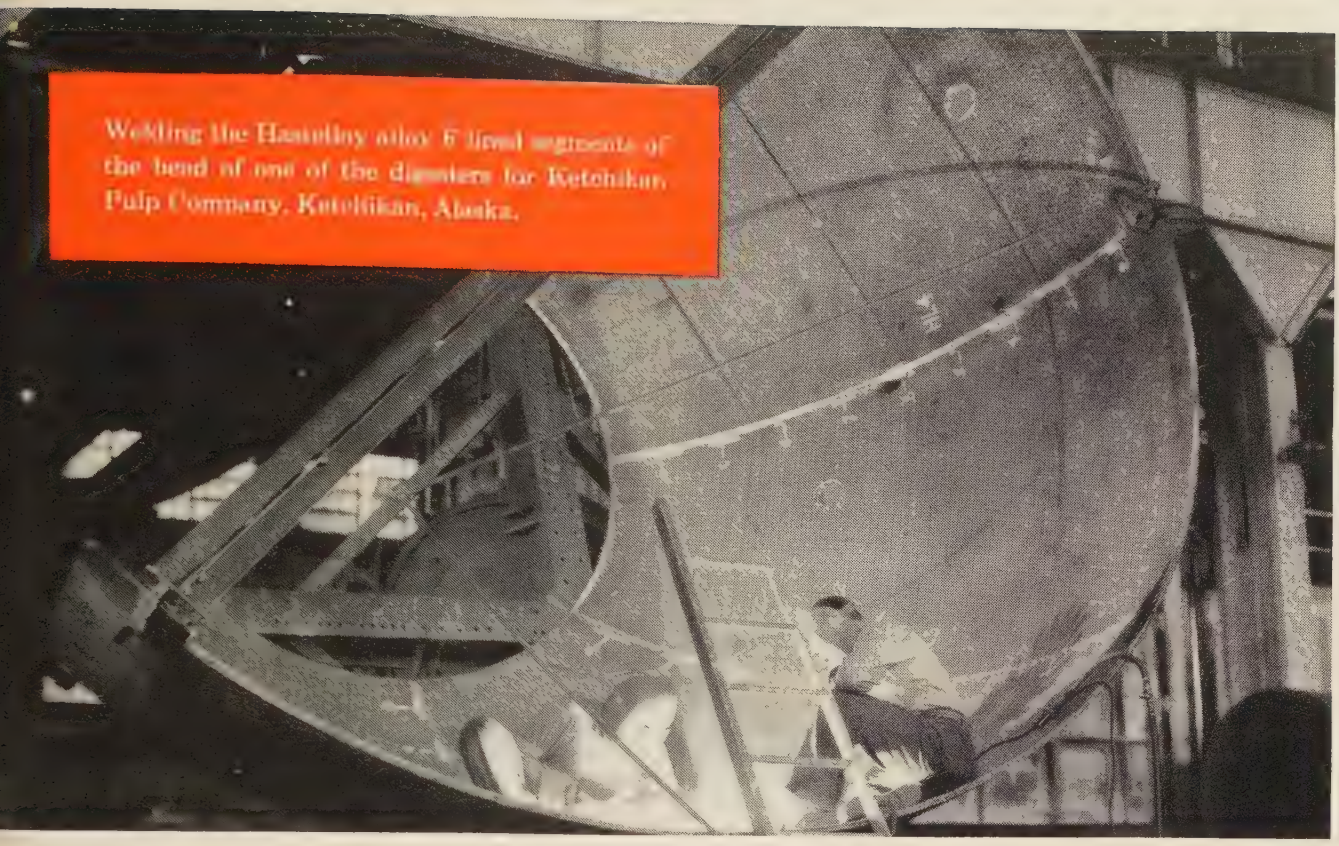
[a] Source: APPA Survey, July, 1953.

These capacities include planned increases to be brought in during the calendar year 1953.

Estimates of production for the year, based on 9 months actual (when applied against these capacities), yield the following production ratios (percentages of employment of capacity):

Printing papers	99%	
Fine papers	92½%	
Wrapping and specialty[a]	87%	
Tissue, including sanitary	100%	
Subtotal		93½%
Newsprint	96%	
Paperboard	92%	
Building papers and boards	96%	
Total paper and board		93%

[a] "Coarse papers" including absorbent.



Welding the Hastelloy alloy F lined segments of the head of one of the digesters for Ketchikan Pulp Company, Ketchikan, Alaska.

Two alloys are SMITHlined in a single digester for both liquor and vapor corrosion problems

will provide protection for Alaska's first pulp mill at Ketchikan

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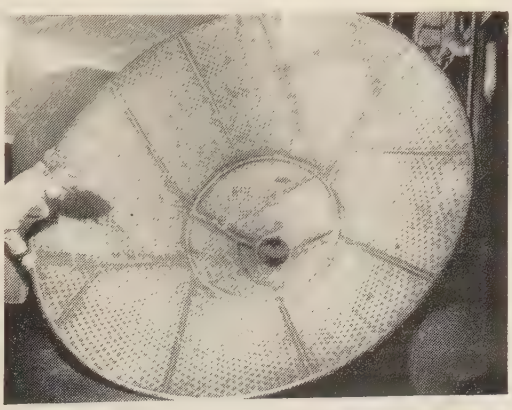
Here the flexibility of the exclusive SMITHlining process excels. With it, two different types of alloy lining are resistance spotwelded to the carbon steel backing of the digester. For example, digesters being fabricated for Ketchikan Pulp Company, Alaska's first pulp mill, will have type 316L (.03% maximum carbon) stainless lining in the area in contact with the liquor, but Hastelloy alloy F* as lining in the vapor area of the dome.

Six 17′ by 58′ digesters for Ketchikan are being fabricated and lined as described. They will produce pulp by the Magnesium Bisulphite (MgO) process. After they have been in service, two periodic inspections by A. O. Smith metallurgists will be made with mill personnel who will learn how to make future inspections and evaluate conditions correctly. This is a service we render to satisfy ourselves as well as our customers on the performance of digesters we supply.

*Registered trade name of Haynes Stellite Company, a Division of Union Carbide & Carbon Corp.

specting the type 316L (.03% maximum rbon) lining in a shell course of the gester.

Inspecting the type 316L (.03% maximum carbon) lining of the digester cone.



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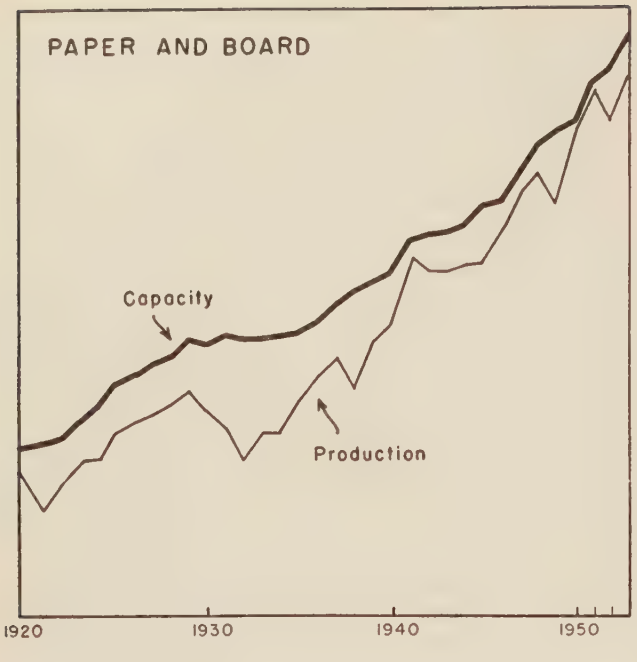

These check, for the grades covered in them, with the weekly production ratios of the National Paperboard Association and the American Paper and Pulp Association after allowance for the differences in the methods of computation in each case.

The two low ratios in the group are in wrapping and specialty (at 87%) and paperboard (at 92%). These two groups have had heavy increases in capacity in 1953. Wrapping and specialty capacity was increased by 12% and paperboard by 8% during the year. Both are fast-growing segments of the industry but the annual growth rate in each case is below the capacity increase in 1953. Under the circumstances, it would appear to be the part of wisdom for producers in the wrapping and specialty field to pause in their development of new capacity until the growth of sales had caught up with capacity. With an average annual growth of almost $4^1/_4$%, it will not take long. In the meantime, 87% operation still means average profits of about 15% on sales before taxes.

The paperboard showing is little short of remarkable. The 8% capacity increases in 1953 will be practically a million tons annually. Despite this tremendous increase in tonnage, the judgments of the managements of paperboard mills have been vindicated by their production ratios this year. With a 92% ratio based upon tonnage production or 94% based upon machine widths, the paperboard group has been able to take care of its growing demand. In one recent week, the paperboard production ratio was 100%, showing that the capacity increase was fully justified. With a 3.1% capacity increase scheduled for 1954, a shortage of capacity is envisaged if an average annual growth of 4% in consumption should be piled upon this year's record.

With the one exception of wrapping and specialty papers, all major segments of the industry are now operating well over 90% and the over-all average is 93%.

Even with this high level of operations, there are bound to be marginal mills in a competitive enterprise system; consequently, some mills are running below the average, while others are running above it. To those running below the average there may seem to be "overcapacity" while those at and above this high average are being pushed for delivery by their customers. This may vary by grades and also by mills within a grade. But a steady average operation of 93% of capacity is certainly good business in the paper industry and is far from a condition of "overcapacity."

By way of comparison, the industry never reached an annual production ratio above 85.7% from 1899 through 1940. The three high years were the boom years of 1917 at 82.9%; 1920 at 84.1%, and 1940 at 85.7%. The 1929 ratio was 81.3%. All of these years were profitable years and there is good evidence in earnings reports already in for the first three quarters that this present year is being profitable.

The fact that the industry is now consistently operating at higher ratios of production to capacity indicates better control by managements over these ratios than in the past and a more prosperous industry. The tremendous growth of the uses of paper has been a contributing factor.

OVERCAPACITY DEFINED

It might be argued that if general business turns down next year, the consumption of paper will turn down and thus create overcapacity. That gets us into a question of semantics in the definition of overcapacity. Overcapacity in the sense the term is used here is a capacity that substantially exceeds the highest demand that can be expected. In this sense, it is not overcapacity when one is able to meet peak demands. That is considered to be one of the normal functions of a manufacturer.

Certainly the above record indicates that, realistically speaking, the paper industry is not overcapacity at the present demand level.

CAPACITY INCREASES IN 1954

Plans and programs for increases in capacity to be completed and installed by Jan. 1, 1955, are shown in the following table.

	Planned increases, Jan. 1, 1954, to Jan. 1, 1955[a]	
	Annual production capacity (1000 tons)	*Increase over 1953, %*
Paper		
Book and groundwood	26	0.7
Fine	15	1.1
Wrapping and specialty	10	0.2
Tissue	34	2.3
Absorbent	...	...
Newsprint	217	19.9
Building	...	...
Total paper	302	
Board		
Building	40	2.5
Paperboard	418	3.1
Total board	458	
Total paper and board	760	2.7

[a] Source: APPA July, 1953, Survey.

Percentage-wise, these increases are negligible with the exception of newsprint with about 20% and paperboard with 3.1%. In every other segment, the average annual growth is more than double the above increases.

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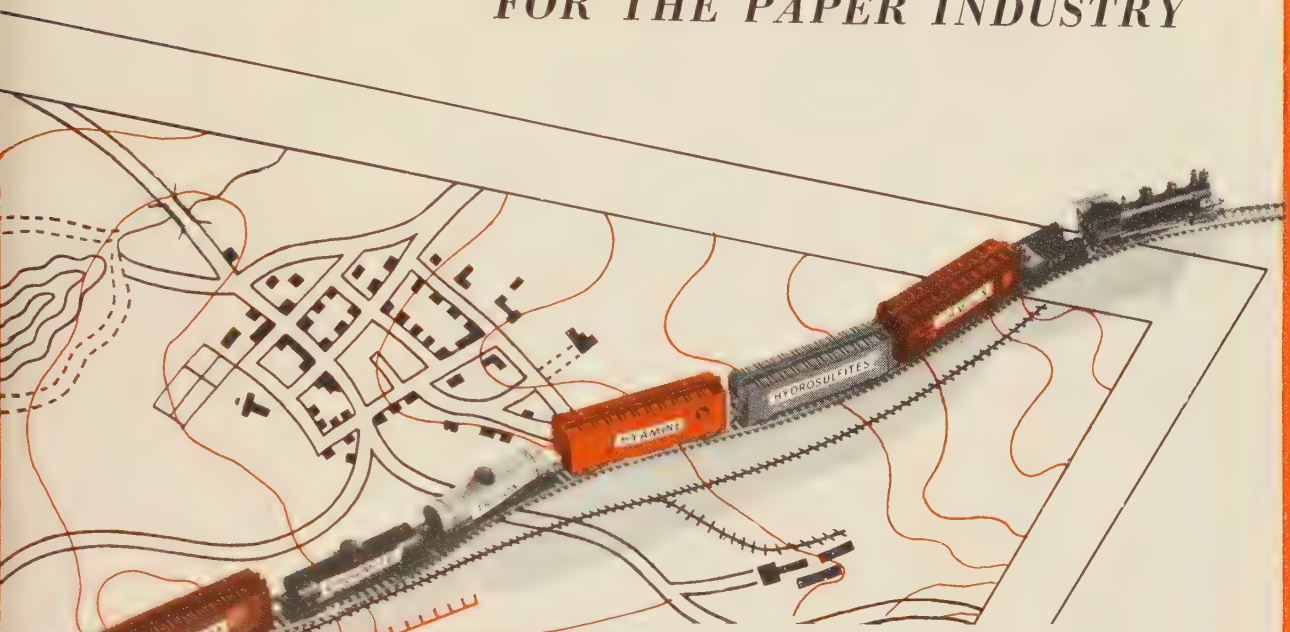

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INDEXES OF CONSUMPTION AND PRODUCTION

Source. American Paper and Pulp Association

The newsprint increase in capacity is largely due to the Great Northern Paper Co.'s program and the mill now under construction by Bowaters Southern Paper Co. These increases loom large when compared with United States *capacity* but as a percentage of the 6 million tons *consumed* in this country, they run but a little over 3.6%. Neither company should find difficulty in selling the product.

These programs, that will be completed during 1954, have been started and certainly cannot create an overcapacity as the industry is now operating. In the present rate of operations, tremendous capacity increases have already been absorbed. Since 1946, paper capacity has increased 28% and paperboard capacity by 53%, with an average increase of 40% for the industry. All that tremendous increase has been absorbed in the current 93% of capacity operations of this year.

The predictions of a recession by 1954 that have been put forth by many have evidently had the effect of slowing the expansion of the paper industry. What will happen if, on top of the present business, the industry should next year enjoy its average growth of about 4.7%? The answer is plain—a tight supply situation in many grades of paper.

CHARACTERISTICS OF THE DEMAND FOR PAPER AND BOARD

With the exception of sanitary and a few other grades, paper and paperboard are commodities that are seldom purchased directly by consumers. They are indirect or "derived demand," sales that are dependent upon the sale of other commodities, such as books, magazines, breakfast foods, soap, cement, radios, houses, cigarettes, etc. As a result the paper industry is sometimes called a "service industry" for it is dependent for a large part of its volume upon the activities of other industries.

However, observation for over 50 years shows clearly that the consumption of paper in the United States because of the constant development of new uses, grows faster than population, faster than the gross national product, and that while this growth in consumption slows down with general business activity, it is a well-established fact that in the past, the bottom of each such slowdown has been higher than the next previous one. The industry is undoubtedly a growth industry and this factor continues to operate.

THE CHARTS OF PRODUCTION AND CONSUMPTION

In any industry a major management problem is to keep production as close to consumption as possible in order to avoid inventory distortions and overproduction.

The accompanying figures show indexes of production and consumption for two of the major segments of the paper industry—paperboard and paper excluding newsprint and building paper.

These charts show clearly the overbuying by customers at the beginning of World War II, the reaction in 1942, the wartime stimulation of paperboard production, and the War Production Board restriction of paper production below consumption requirements. The 1948–49 drop in consumption and the accompanying correctional drop in production are apparent in each chart. The sharp recovery of consumption in 1949 and rapid upswing of production were accentuated by the Korean boom. But production ran ahead of consumption and inventories were built up. The downward correction began in 1951 in paperboard, continuing through two quarters of 1952. The downward paper correction occurred in early 1952. In the middle of that year, consumption increased with production following it for both segments. However, in 1953, *paper* consumption has remained above production, whereas the *paperboard* production index has been above the consumption index since August, 1952, with seasonal dips below it in December, 1952, and July, 1953.

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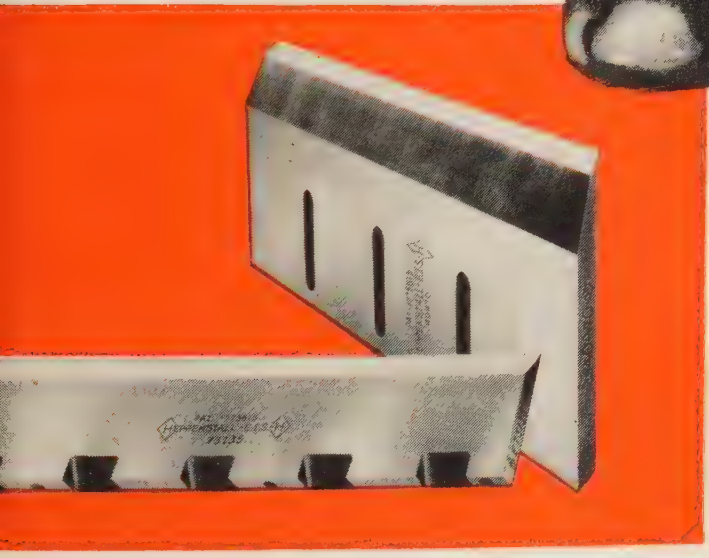

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The past 14 years have been eventful ones for the world, this country, and the United States paper industry. The major international events, particularly wars and rumors of war, are reflected in the behavior of these two charts. It is clear that war and threat of war stimulate buying of paper and board beyond the immediate needs for consumption and also that consumption has enjoyed a comparatively steady growth both during and after wars. The fears and emotions of buyers have resulted in scare buying that at times has caused the illusion of shortages which, without these fears, would not have existed in fact. These emotional factors prevailed in 1939, 1940, 1941, and part of 1942 and from mid-1950 through the early part of 1951 in paperboard and through the early part of 1952 in paper. The recovery of consumption later in 1952 set off an extremely sharp upswing in paperboard production and a slightly milder one in paper production.

PRESENT POSITION OF THE INDUSTRY

The present position of the industry as indicated by these charts may be briefly summarized as follows:

1. There is at present no inventory accumulation in the channels of distribution for the paper grades. Inventories have been brought down substantially since May, 1952.

2. Since August, 1952, there has been some accumulation of inventories in the channels of distribution of paperboard.

These statements are confirmed by direct information from the trade.

LIMITATION OF THE INDEX OF CONSUMPTION

The indexes of consumption shown in the charts are adjusted for long term growth factors and any sharp current change in these factors will not be immediately reflected. The likelihood of such distortion in these charts is not considered great because they are adjusted for growth factors through June, 1953.

FORECAST FOR 1954

On the basis of this analysis, what can be expected in 1954? The indexes of consumption reached peaks in March, 1953 of 130 for paperboard and 125 for the paper index, with the production indexes running generally above consumption for paperboard and below it for paper. If past behavior in these *consumption* indexes should be followed, low points could be reached in March, 1954 of about 120 in paperboard and 116 in the paper index with the averages estimated for the year at about 126 for paperboard and 121 for paper.

Inasmuch as paperboard *production* has been exceeding *consumption* in 1953, it is to be expected that it will drop below consumption in 1954. On this basis, the average monthly production index is estimated at 124 for the year 1954.

The reverse situation applies to the paper production index which is estimated at 123 for 1954 because its *production* has been below *consumption* in 1953. On these forecasts, the following summary is based assuming also that the building paper and board productions will approximate 1952 volumes, and United States newsprint will rise to 1,200,000 tons. In the final columns is shown, for comparison, the 1953 production ratios.

	Forecast—1954			*1953*
	Capacity (1000 tons)	*Production (1000 tons)*	*Production ratio, %*	*Production ratios, %*
Paper	11,000	10,600	96	93½
Paperboard	14,000	11,600	83	92
Newsprint	1,310	1,200	92	96
Building paper Building board	1,389 1,600	2,600	87	96
Totals	29,299	26,000	89	93

These forecasts are based on past experience with the index of consumption and represent the minimum that should be expected under normal peacetime conditions. They are here tabulated beside the corresponding estimates for 1953:

	Production forecasts, millions of tons	
	1953	*1954*
Paper, ex-newsprint and building paper	10.2	10.6
Paperboard	12.5	11.6
Newsprint	1.1	1.2
Building paper and board	2.8	2.6
Total	26.6	26.0
Ratio of production to capacity, %	93	89

The production ratios of 93% for 1953 and 89% for 1954, the latter a probable minimum, clearly indicate that there is no overexpansion of capacity in prospect in the paper industry. Should a sharp upturn in orders occur in 1954, the industry could be hard put to it to meet them.

EFFECT ON EARNINGS

Studies by the American Paper & Pulp Association indicate that there is a rough relationship between the production ratio and average earnings before taxes as a percentage of sales in the primary paper industry. Using the ratios established by these studies, the primary paper industry should expect average earnings before taxes as a per cent of sales for the year 1953 of about 18% and for the year 1954, of over 16%.

It should be recognized that these 1954 forecasts are minimums. They indicate the probable effects of a recession which many individuals expect next year. There are factors in the economy, such as lowered interest rates and a firming price level in primary markets, which are operating to check a recession. At present, the author's belief is that the weight of evidence is against such a recession. If one should occur, the average earnings on sales before taxes should not drop below 16% for the primary paper manufacturing industry.

Of course, an outbreak of hostilities or other major international crisis could start at any time another upswing which would tighten up the supply-demand position. Even the normal or average growth on top of this 1953 production could result in shortages in paperboard and many paper grades. These events, if they occur, would result in higher production ratios and higher profits before taxes.

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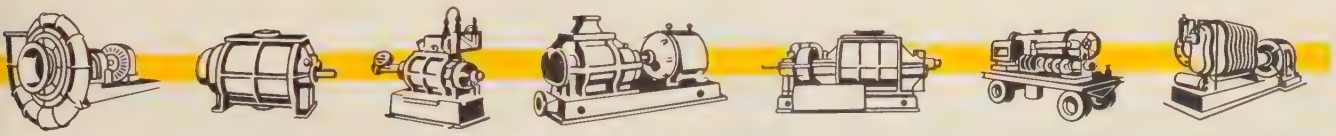

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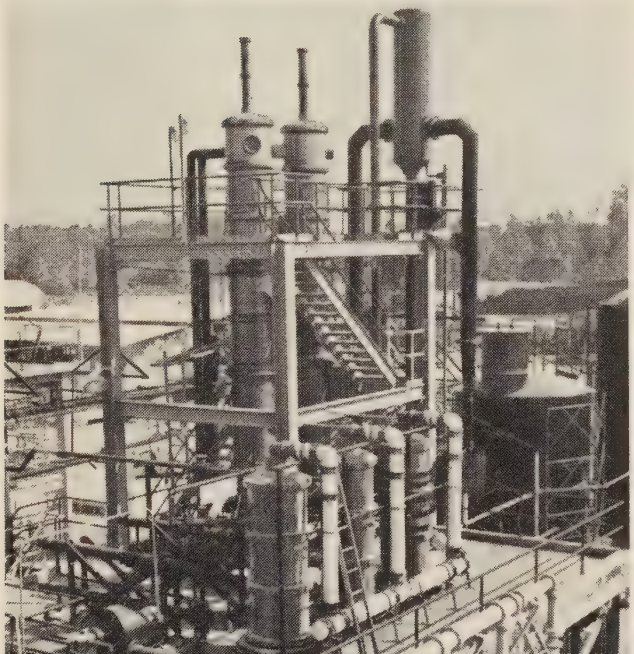

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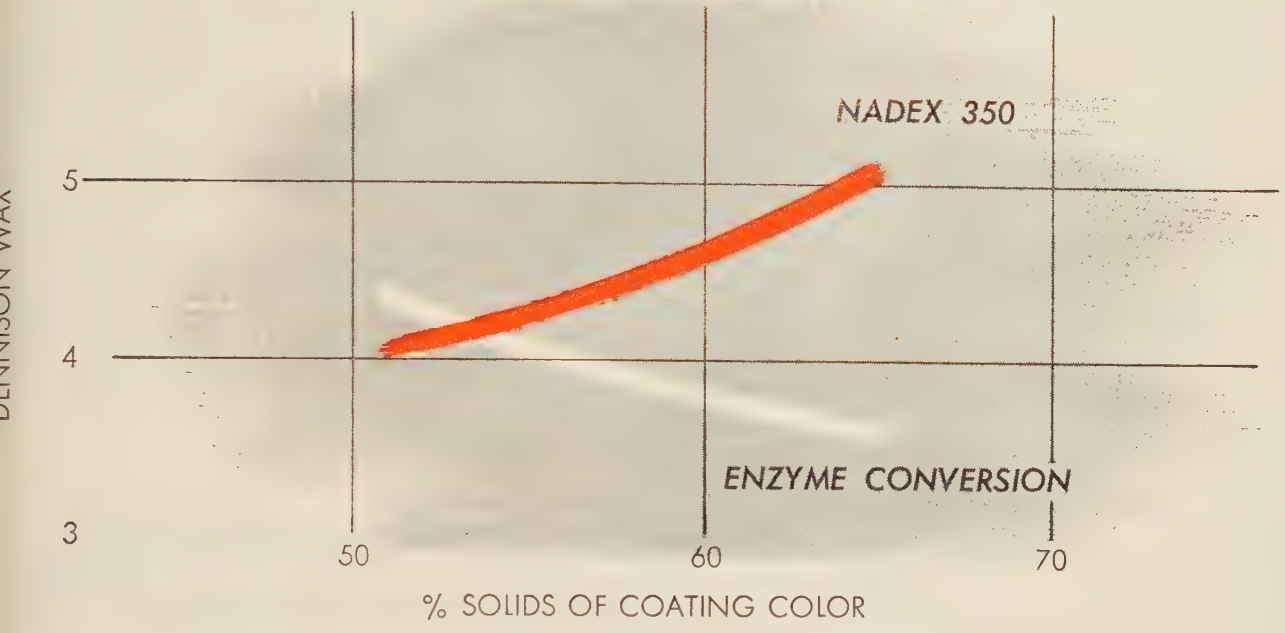

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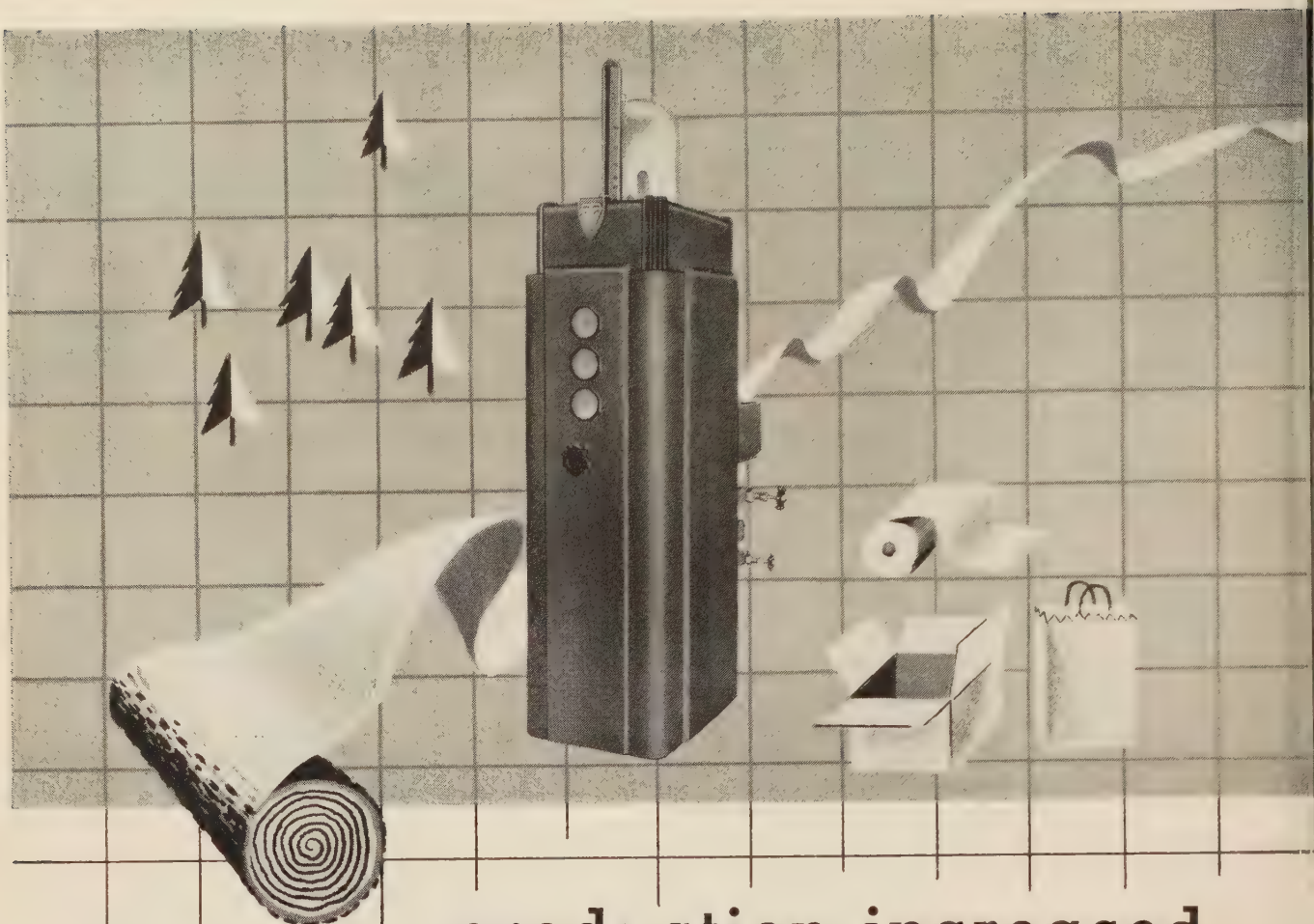

production increased up to 15 tons per day...

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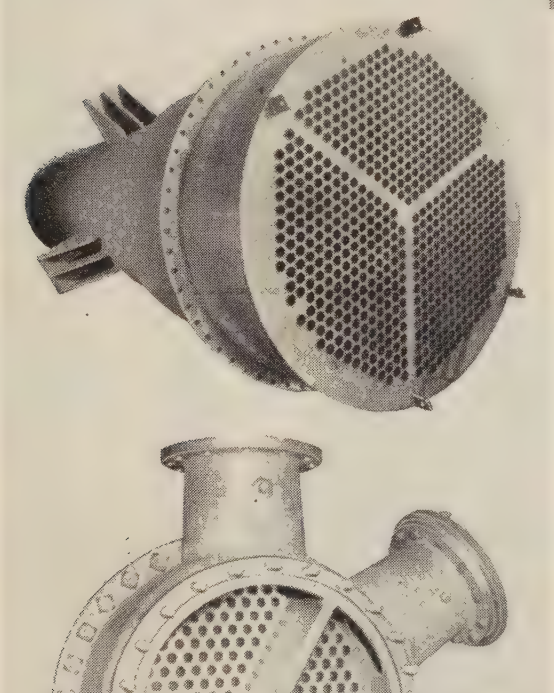

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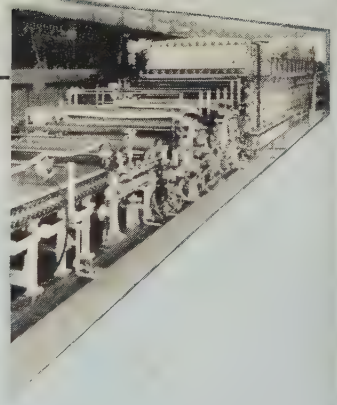

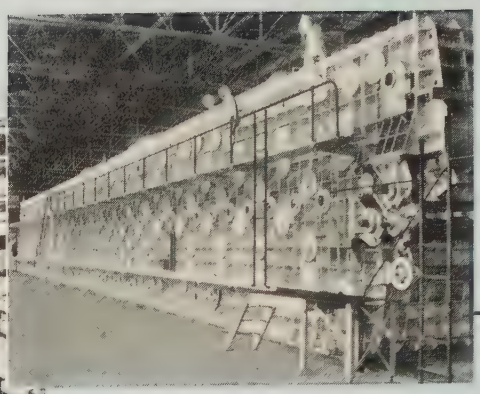

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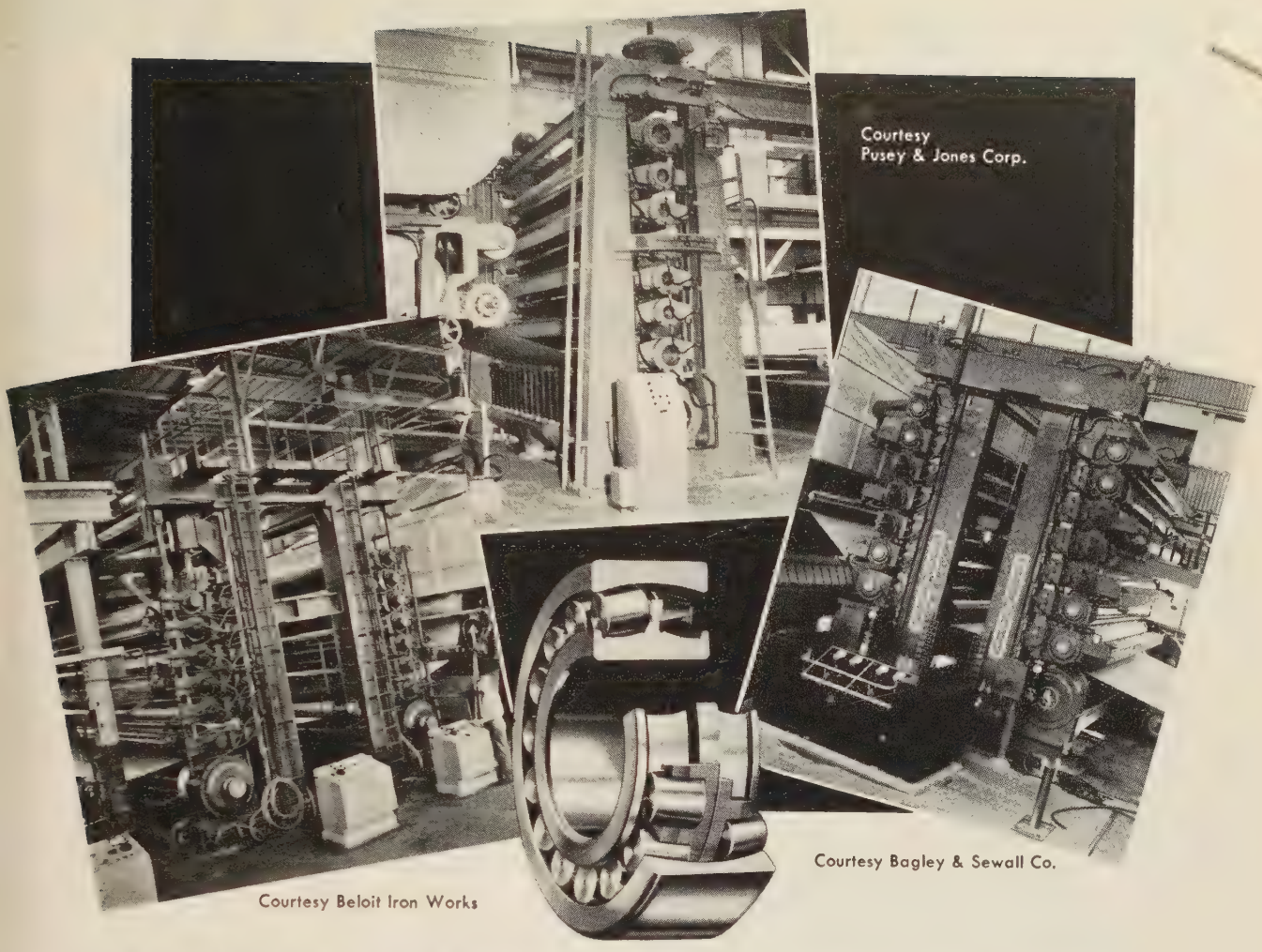

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WHAT IS PUBLIC RELATIONS

KARL R. BENDETSEN

Karl R. Bendetsen

No one with any experience in the field of public relations would tackle the subject you have asked me to discuss without considerable misgivings. Those of us who have given time to problems of a public relations nature in business and industry have had to learn by doing. Experience teaches us that there are no stock answers to problems in public relations.

However, I welcome this opportunity to discuss this important subject with you and I will do my best to give you some views on what I consider to be the nature and purpose of public relations in business and industry. There never was a time when it was more important that the subject not only be understood and appreciated but that its principles be practiced.

Any concept of public relations depends upon what we consider to be the function of business itself. Some years ago an industrial leader said that the function of business is to do a useful thing in an economical manner. We must today qualify this definition somewhat by adding a condition—and this is important—that useful service and economical operation must be understood and approved by the people who receive the benefits. It seems to me it would be more accurate therefore to say that business serves its basic function when it provides people with goods and services they need in a manner that promotes the welfare of society as a whole within the frame work of the free enterprise system.

Thus the first conclusion I would lay before you is that people expect more of business than the performance of useful and economical services alone. People expect business to be a good citizen. They reserve the right to define what constitutes good citizenship. It is fundamental therefore that we recognize that there is no such thing as a private or a personal business enterprise. All business is influenced by forces beyond its control. Consequently, anything business does involves some kind of a problem in public relations.

Recognition of the political nature of the society in which we live has resulted in the adoption by representative business of what has been called the doctrine of enlightened self-interest. This holds that considerations of public policy must ofttimes take precedence over considerations of profit. This point of view looks upon profit as the legitimate by-product of a socially useful service efficiently performed. It recognizes that society will not long permit the continuance of a business whose *only* justification is financial success.

With these thoughts in mind it is pertinent to remember that the social responsibilities of business are defined by public opinion. No longer can business afford to rest its case solely upon customer satisfaction measured in terms of price, quality, and service. It must also prove its social and economical worth through the assumption of responsibility for the local, state, and national welfare. And it must be willing to rest its case upon the full facts concerning itself made available to the people on the assumption that the verdict of an informed citizenry is conclusive and sound.

So much for a few generalizations. Perhaps it would be helpful if we were to take a look at some examples of what some have commonly described as public relations. If we can agree on what is *not* public relations as a function we can better understand what the function really is.

Fortune Magazine not long ago published a list of a broad range of activities which people commonly include, describe, or think of as public relations. I will quote from this article:

"Somebody called it public relations at work

—when Samuel Insull facing trial was coached by Steve Hannagan to live in a second rate hotel and ride on buses.

—when Beechnut through Bernays got doctors to advocate big breakfasts knowing that the result would be more bacon sold.

—when society leaders, previously 'convinced' by Bernays came out with the statement that a woman should take at least three dresses on the most informal weekend and the luggage industry as per plan began to sell more bags.

—when President Hoover, Thomas Edison, and Henry Ford under Bernays' guidance gathered at Dearborn to celebrate Lights' Modern Jubilee and the first lamp appeared on a commemorative postage stamp.

—when you noticed that the truck blocking your way had written on its rear 'Our drivers are instructed to give you the courtesy of the road.'

—when the railroad dining car gave you a cup of black coffee free for breakfast.

Karl R. Bendetsen General Consultant and Assistant Division Manager (Texas Div.), Champion Paper and Fibre Co., Pasadena, Tex.

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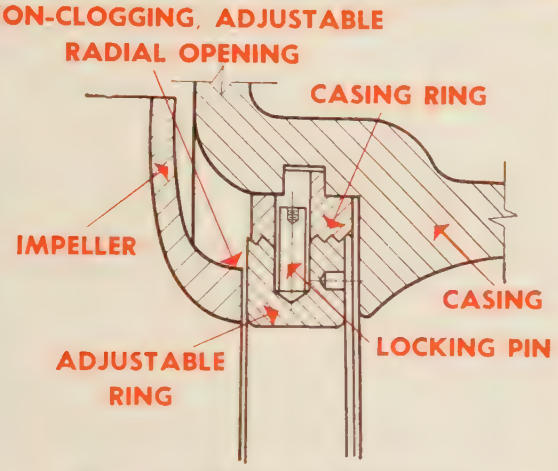

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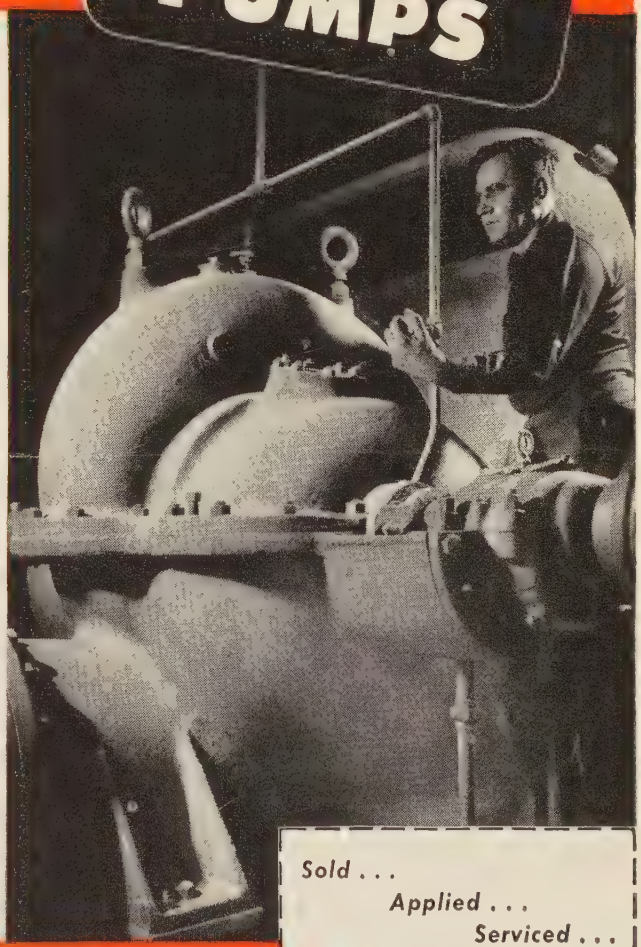

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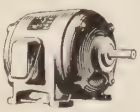

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ALLIS-CHALMERS

—when the Metropolitan Life Insurance Co. told you in its advertisements how to take care of your health and thereby made you not only a friend but a better risk."

In my opinion none of these examples should be classed as public relations. To be sure they were all fine ideas—they sold more luggage and bacon; perhaps caused some people to prefer one railroad over another one; may have softened Mr. Insull's legal difficulty, but they were essentially promotional. They were publicity stunts aimed at influencing Mr. and Mrs. Jones as customers rather than as citizens.

Now one of the most important single things to realize in analyzing the nature and purpose of public relations or in dealing with the public relations problems of a business or an industry is to realize that the man in the street thinks one way as a customer and another way as a citizen. He may think X product is fine and buy it regularly. He may also think that X company who makes the product is antisocial and vote for a severe regulatory law that may cripple or destroy it. It is his thinking as a citizen which eventually becomes what is known as public opinion or sentiment.

Therefore public relations is essentially the function of molding public opinion. Of this function Abraham Lincoln once wrote a perfect description: "Public sentiment is everything. With public sentiment nothing can fail; but without it, nothing can succeed. Consequently he who molds public sentiment goes deeper than he who enacts statutes or pronounces decisions." But it is in the actual job of molding public opinion that the nature of public relations is so often misunderstood. Let's consider some of these misunderstandings.

First there is the notion that the public relations work is a philanthropic undertaking. Enthusiasts of this school of thought subscribe to a gospel of social uplift which in their zeal they confuse with the practical job of helping business keep abreast. They operate on the theory that public relations is the job of dispensing charitable donations or something of the like.

Probably one of the most common misconceptions of the public relations job is the ballyhoo concept. Some people think it means an attempt to create mass hypnotism, intellectual jujitsu. Others think it is high-pressure salesmanship, that it is the work of a publicity agent. It is unfortunate that public relations is thought of by so many people as a publicity job and its effectiveness judged by the amount of free newspaper space. This shallow, superficial treatment of symptoms rather than the cause is the ballyhoo style and while it may make a spectacular showing it is unsound and mistaken and can be dangerous. Good public relations may often involve knowing when to be silent as well as knowing what to say and when to say it.

Another misconception is the habit of thinking that there is a general public, or to put it another way, the failure to recognize what constitutes the public. Actually there is no general public. There are many publics, each differing in interest and attitude from the others. Let me be more specific. Business carries on its relations with employees, customers, stockholders, suppliers, landlords, bankers, transportation companies, competitors, government, community groups, and many others. These groups are made up of people or individuals whose thoughts and feelings are not subject to classification except as they are touched by the element of personal interest. Some have called it the element of pocketbook interest. The task of business, as I see it, is to know all the groups of people with whom it deals and to study these individual group interests and to survey their opinions as individuals. No single program can be planned to serve effectively the interests of all groups. Special consideration must be given to each of the many publics in whose hands the ultimate fate of business rests. Public relations is therefore primarily human relations.

Practically every industrial group has an opposition with which it struggles for the balance of power in public opinion. The balance of power is represented by that section of the public which happens to have no personal interest in either side. This disinterested public must be influenced primarily by minority groups and organizing such groups into effective friends requires the maintenance of successful relations with the elements of which it is composed.

One of the most important of all misconceptions is that of viewing the public relations aspect of a business or industry as something extra or outside of the regular operation of the business. Whatever is done in the name of public relations can be no more effective than the philosophy of the management itself. This means that sound public relations must begin at the top where policies are made.

Not long ago a widely respected public relations adviser said that American business had passed through four distinct periods of growth and was now entering the fifth. In his opinion the first phase was that of the production man, that is, it was the era of the builder and inventor who knew how to produce something that people could use. He said that the second stage was that of the financier who brought together the collective capital which was required to enable industry to grow. The third stage was the era of governmental regulation through the Sherman and Clayton Acts which after the turn of the century were passed to insure continued operation of industry in the public interest. The fourth stage was the one that brought salesmen into ascendancy. This he said was the era of spreading markets and intense competition. In commenting on the fifth stage he had this to say and I quote: "I affirm with confidence that tomorrow belongs to the man who thinks in terms of the public—the public embraces his employees, his stockholders, his customers, his neighbors surrounding his factories, often the national body politic—and his government. These are the groups that are going to take a lot of pleasing in the years that are just around the corner. These are the publics about whose relations to industry modern business leadership is giving the most intense thought."

Public relations is basically simple and easily attainable but as with most things that are basically simple it has been elusive to many and subject to a wide variety of interpretations. A good measure of the soundness of the public relations function is its survival despite the many crimes which have been committed in its name. For the term has been used to cover everything from circus press-agentry to the manipulation of Capitol Hill lobbies, and as I have said, it is most com-

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monly confused with propaganda, promotion, and plain ballyhoo.

Much of the confusion that has surrounded the term public relations arises from the tendency of many people, including some so-called professionals in the field, to identify the operation or evaluate it in terms of the tools sometimes, but not always, employed. Thus to some groups we find the clearest reason why it has meant publicity. Others profoundly discuss public relations in terms of institutional advertising. True a public relations program may utilize both of these and properly so.

Then we have a large group of wishful thinkers. Many of these have top positions in management. They are the boys who regard the business of public relations as some kind of witchcraft. Whenever they are confronted with a bad situation with the public (or as we recall, a special part of the public) or with its employees they send out hopefully in search of this modern witch doctor who is supposed to smooth out the difficulty with the aid of some mumbo jumbo and a few facile publicity stunts. This fellow then wants to sit back blissfully in the soft embrace of the more abundant life.

Public relations is a philosophy of management, a fundamental attitude of mind. It must originate at the top where policies are made, for upon these policies will hinge the success or failure of the program. No amount of clever manipulation will compensate for any basic error here.

These policies must be based upon enlightened self-interest, upon a complete understanding by management of the exact nature of its problems and of the corrective measures that should be employed if policies and practices are in conflict with the public opinion. There must exist on the part of top executives a willingness to accept cold facts about their businesses and their conduct, however distasteful.

Actually I don't think there has been enough frank talk about the purposes of public relations with relation to business and industry. A good many discussions I have read have used such phrases as "reselling business to the public" and "developing an operating philosophy which recognizes the social responsibilities of business" or "making people want to do business with you."

Such generalities are partially correct. But they do not tell the whole story and tend to cloud the issue and confuse many practical businessmen who are intelligently searching for an understanding of public relations and how it might be used in their operations.

Successful public relations in practice is a competitive weapon. It is used both defensively and offensively to protect and to improve positions. Some programs are aimed at furthering the interests of an individual company; others at furthering the interest of industrial groups and still others are joint programs combining several industrial groups such as the National Association of Manufacturers which undertakes to act in the interest of the business community as a whole.

I place emphasis on the element of competition because it brings public relations down to earth and illustrates its role as a necessary and useful part of a profit system. The railroads and the trucking interests are competing for public opinion on many fronts. The chain stores and the wholesalers have been engaged fo many years in a bitter battle which has been responsib for several of the major public relations operations in th country. The privately owned utilities have estal lished public relations programs as a defense agains the activities of the minority pressure groups for publ ownership. The automobile and telephone companie were among the first to recognize public relations as a inherent operating function because their size alon made them highly vulnerable in competing with th politician for the confidence of the public. In ever case there is a fundamental defense of capital, profi or rights against competitive business or ideologica pressure groups who are offensively campaigning Thus it is easy to see why as we said earlier tha business competition is no longer confined to th simple factors of price, quality, and service for th patronage of John Doe as customer. The fourt factor has been added. It involves the competition o opposing public relations programs for the favorabl public opinion of John Doe, not as a customer but as citizen.

This is a big subject and one which cannot be ade quately dealt with in the brief time allotted to me. Th best I can do and what I have tried to do is to give yo some highlights. Public relations is not just a job in special public relations office or department. It is par of the job of everybody from president to office bo and of everything that is done from a determinatio of executive policy to pushing your end product int the railroad car. It requires continuing effort. Th several publics of which the general public is made u are unpredictable enough but the problem becomes th more complicated when it is recalled that the public not the only unpredictable factor. Top manageme and top executives also are given to moods, fits o temperament, stubbornness, and all the other hum failings. Public relations practitioners often agree tha their toughest problems are encountered in trying t convince top management that the public often see things differently from the perspective of top manage ment. Public relations is a function which cannot b delegated. It is the practice, the duty, and the respon sibility of everyone in the organization from the top t the bottom.

It must rest upon getting the facts—knowing wha the problems are. Increasingly today, opinion re search, and these are the facts I am talking about, becoming an indispensable tool of public relation You might say that the public relations problem alway breaks down into two parts. The "what is it?" par and the "what to do about it?" part. There is n substitute for fact-finding. It is the base of the whol function. If a public relations adviser is to offer wis counsel he must know the reasons behind his ever move. I like to refer to the lines of Rudyard Kipling

> "I have six honest serving-men
> (They taught me all I knew);
> Their names are What and Why and When
> And How and Where and Who."

Let us consider still another aspect of our problem There is of course no substitute for being right. Bu oddly this alone is not enough. You must not only b

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right; you must also seem to be right. The law of cause and effect has never been repealed and never will be. If a business or a person is wrong in his conduct he will not escape an ultimate penalty no matter how much effort is devoted to arguing the point or plain deception. On the other hand, if a business or an individual is right in its conduct it will still have a rough time if it does not seem to be right—if it is misunderstood. Therefore, an important aspect of the public relations responsibility any organization bears—and hence which each of you bears as members of your respective organizations—is to determine the facts: what does the public think of you? You may be right but do people or interested groups think so? If not, you had better act to explain yourself and clarify the matter.

In this connection, all of us have heard others complain of unfair treatment at the hands of the press or the radio. Such people are overdue in a much-needed diagnosis of themselves. For the most part I know of no group who are more anxious, ready, and willing to cooperate in helping you get the facts before the public in an understandable way. They ask only that you do your part in making it possible for them to perform this service. They can't read your mind and if you force them to guess at the facts it is your fault and not theirs. Although I am new in this area I am sure that I accurately record Champion's experience when I tell you that it has had the finest cooperation from newspapers, periodicals, and members of the working press and radio throughout the areas of Texas in which Champion operates.

The community in which you operate should be of paramount concern. There is no place where anyone is either so much liked or disliked as where he lives. Employees, townspeople, tradesmen observe what goes on. They exchange views on the street corner, at social events, at meetings, at lodge. No company can get away from the opinion folks hold in its hometown or wherever it operates. This requires close understanding and accord between management and its community or communities as well as between employer and employee.

Another phase of the task is to convince yourselves, your colleagues, your superiors, and your subordinates that they have to sell business as well as its products and that accomplishing one will help to accomplish the other. This has to do with what things the public expects an industry to do besides simply producing and distributing goods. You can recall the time when about all a corporation had to do was to pay dividends regularly and publish a stereotyped annual report. Today this doesn't even get by with its own stockholders. And if stockholder confidence is not maintained they will not maintain their investments. Without that no enterprise can succeed or live.

Let's put the matter in its broader sense still another way. Anyone who does business with the public is in public business. No matter who owns the business it is subject to regulation by the public in many ways. There are a great variety of laws applicable to almost every business. They cover matters dealing with incorporation, with the sale of stock, with borrowing, with partnerships, with individuals, with fair trade practices, with fair labor practices, and the like. There are various forms of additional public supervision such as the giving or withholding of patronage. What th all gets down to is that the public really lays down t rules for business partially in laws and partially in publ opinion which at any time may be made into law. T great problem is to find a middle ground in which t vital and essential initiative and drive of private ente prise can be preserved while at the same time t abuses of power on the part of strongly entrench groups, whether industrial, agricultural, or labor c be prevented.

Each of us has an important stake in colleagues' a competitors' acts. A member of the business co munity through his conduct or misconduct can poiso the pond in which we all must fish. The trade a professional association movement is closely related this aspect of the problem. Such associations c provide useful vehicles for a certain phase of any sou public relations program. Their purposes must public service leadership. It must know what t common problems of the business with which it associated are. It must be able to explain them. must help develop good honest rules of citizenshi recognize the civic problems of the various communitie After all, being respected by our neighbors, being a goo American is public relations in action.

I am sure we can agree that this is self-evident: th the public relations of any institution can be describe as the sum of all the impressions made by the institutio itself and of the various persons connected with it. T appearance, the action, the speech, and the writings every person associated with a given enterprise co tribute toward the general impression of that busine Any adverse opinion created, whether it be by the pre dent or by the switchboard operator, may have fa reaching effects. The real instruments of good pub relations are people.

In conclusion, public relations in industry as in li is a function inherent in and inseparable from ev aspect of everyday life, whether the life is an i dividual's, a partnership's, or a corporation's. It neither a substitute nor is it a thing apart. If yo actions are such as to make people have confiden in you, then you can say your public relations a good. If your actions or words lead to lack of co fidence in you, then your public relations are bad. It about that simple to state.

Presented at the Seventh Alkaline Pulping Conference of the Technical Ass ciation of the Pulp and Paper Industry, Houston, Tex., Nov. 18, 1953.

Fifth Coating Conference

Technical Association of the Pulp and Paper Industry

Poland Spring, Me.
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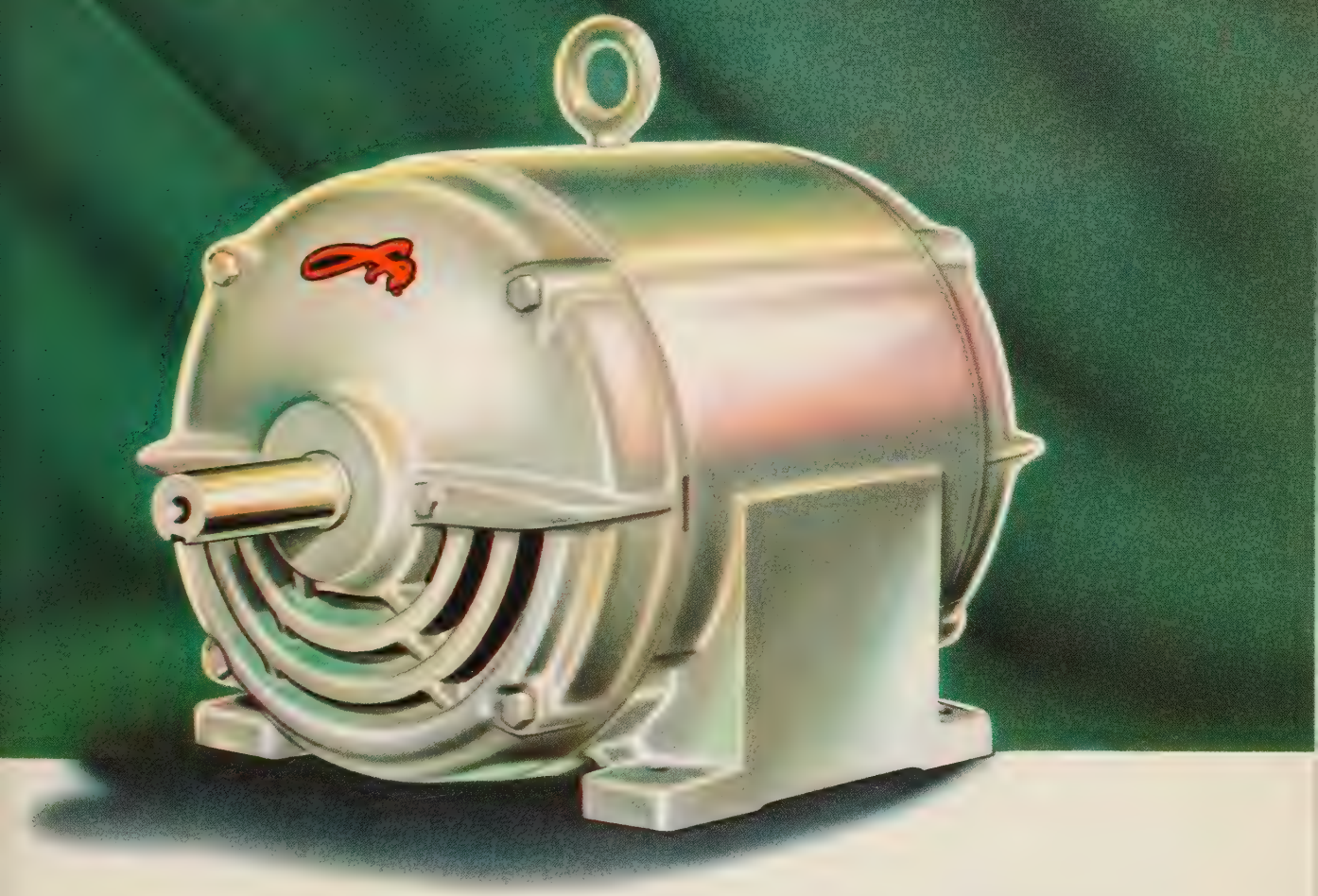
Not just a "face-lifting" to meet the new NEMA standards,
but a completely redesigned motor line

The Louis Allis Co. proudly presents the NEW L.A. *Line of electric motors*



. . . the concentrated utilization of over 50 years of engineering and development brings you this new concept in motors.

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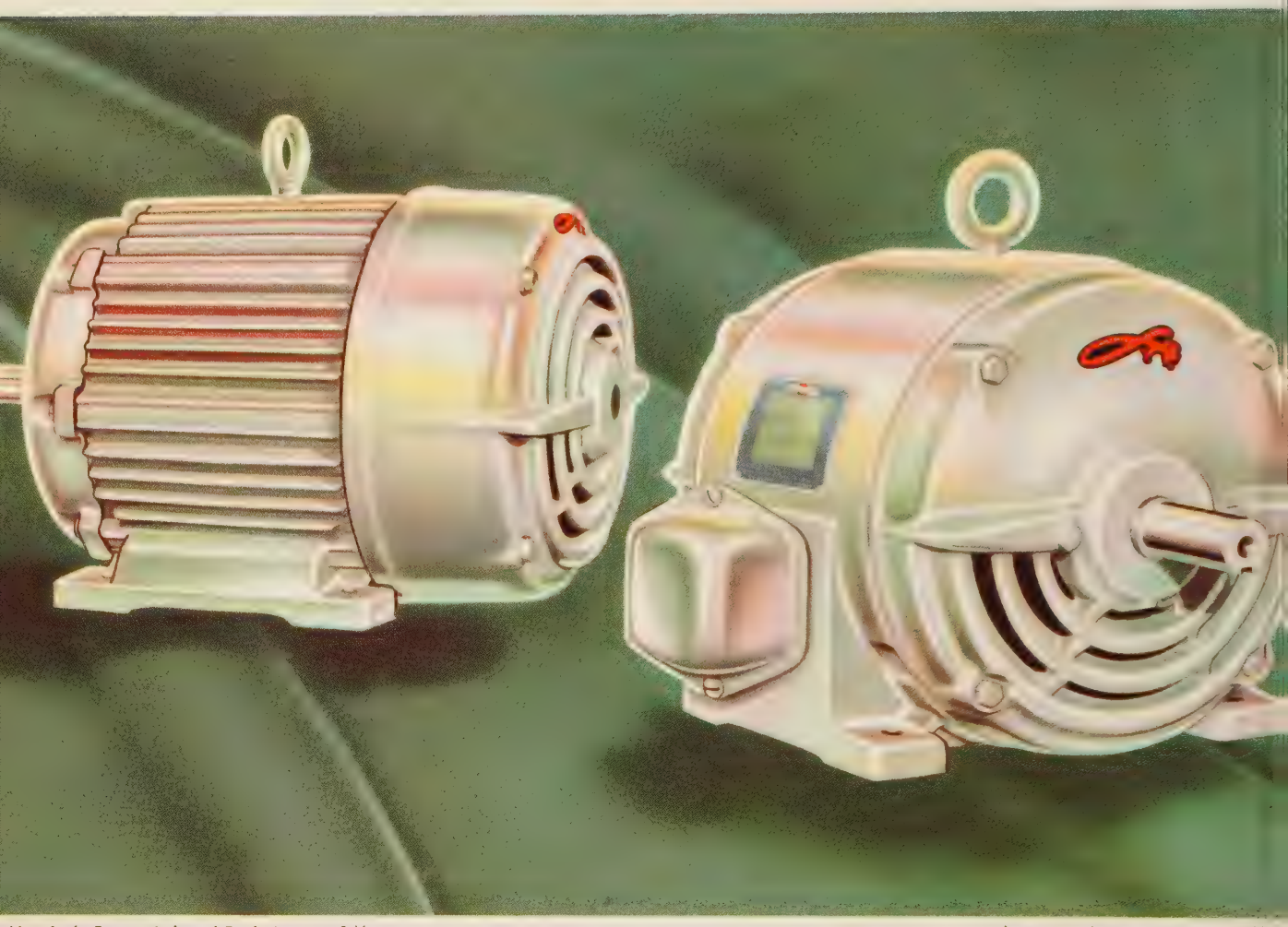
Here's new power for all standard and special motor applications



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From over 50 years of motor building experience and

many famous firsts including

the first fan-cooled, explosion-proof motor
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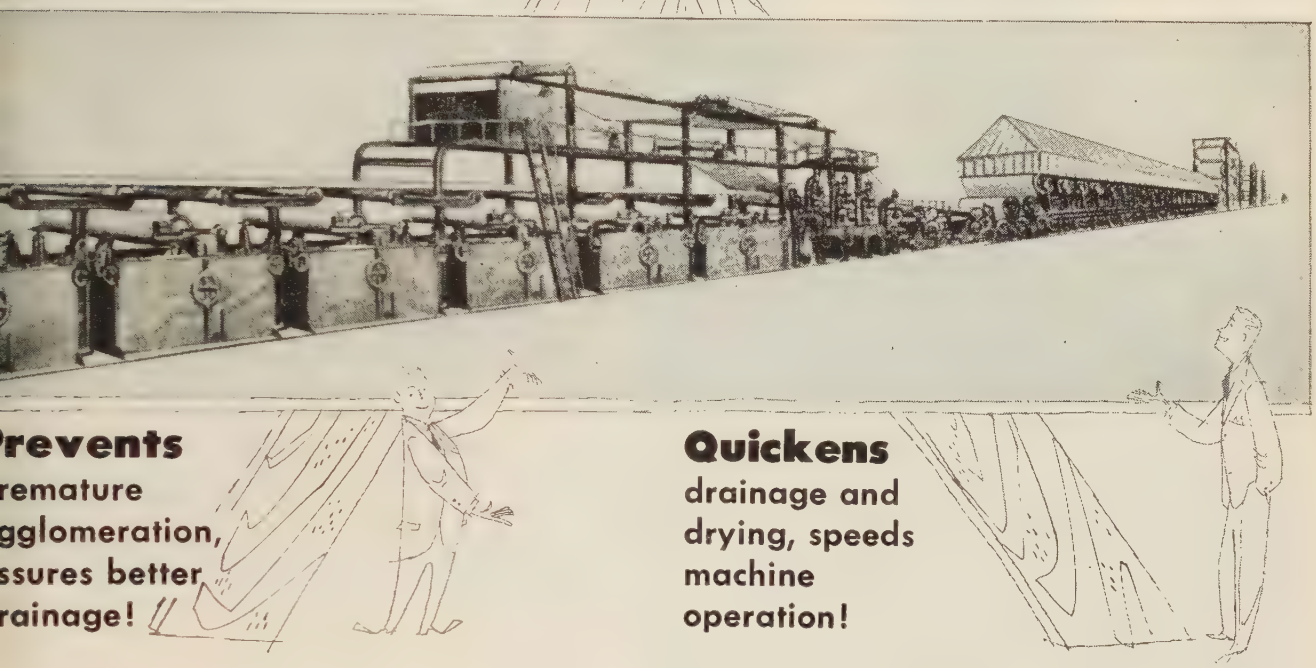
comes the NEW Line

Here's the motor that's entirely new through and through, with such features as new modern styling... improved ventilation ...greater protection... new conduit box arrangement ...new bearing construction... and more versatile mounting. Get the facts on the most up-to-date motors available—the new L.A. line. See how these new motors can provide more power in a smaller package for your product or plant ...with the same high standards of Louis Allis performance, temperature ratings, service factors and torques. Call your Louis Allis Sales Engineer for the complete story.

Special Note *Louis Allis motors, built to the same high standards of quality and performance in the old NEMA standard frame sizes, will still be available if you require them for interchangeability or replacement.*

THE LOUIS ALLIS CO. · MILWAUKEE 7, WISCONSIN

How JM CELITE Johns-Manville improves formation and speeds production...



Prevents premature agglomeration, assures better drainage!

Quickens drainage and drying, speeds machine operation!

Just add a small amount of Celite* to the furnish of your board machines, and you'll find that formation troubles disappear . . . and production is stepped up.

Here's how Celite works: During formation, Celite's porous, irregularly shaped particles help keep the fibres more uniformly dispersed—thus preventing premature agglomeration. This provides better channels for the flow of water . . . gives the initial mat uniform drainage. The result is faster drainage and drying which permits as much as a 10% increase in machine speeds.

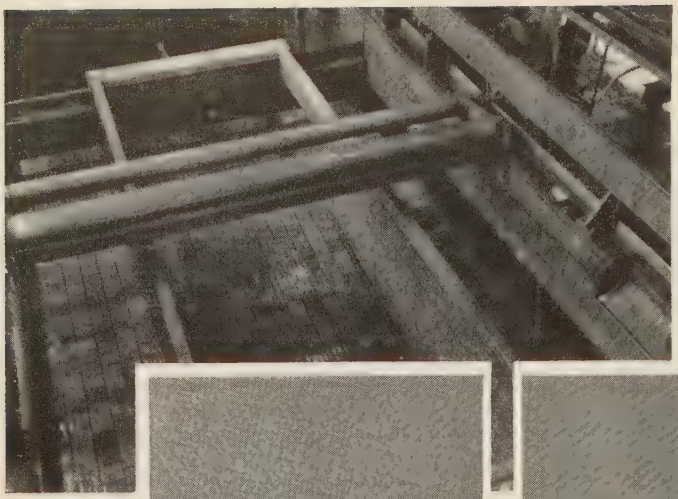
Why not ask a Celite field engineer to call and discuss the use of Celite in your mill? In addition to solving your formation problems . . . there are other ways in which Celite can help you produce better paper at lower cost. Just write to Johns-Manville, Box 60, New York 16, N. Y. In Canada write 199 Bay Street, Toronto 1, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CELITE PRODUCTS

FOR THE PAPER INDUSTRY



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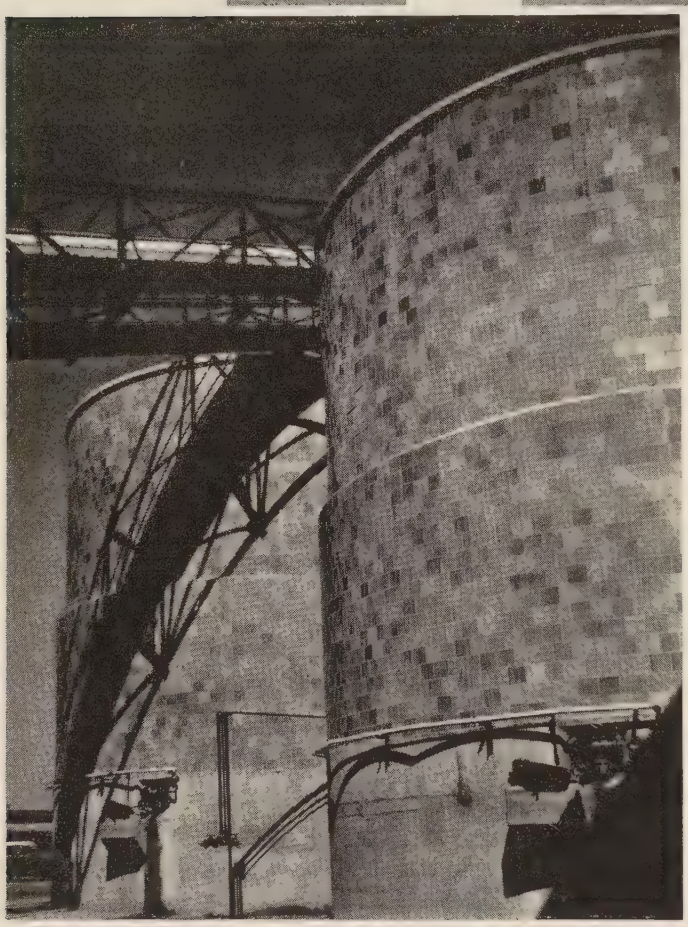

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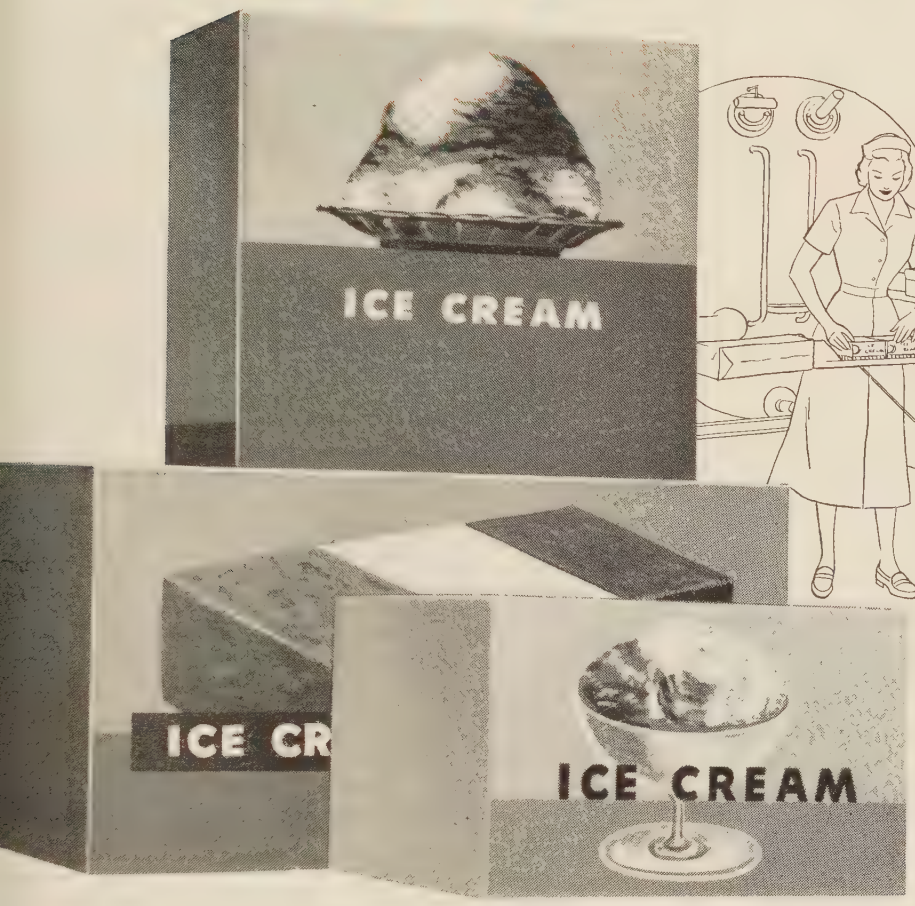

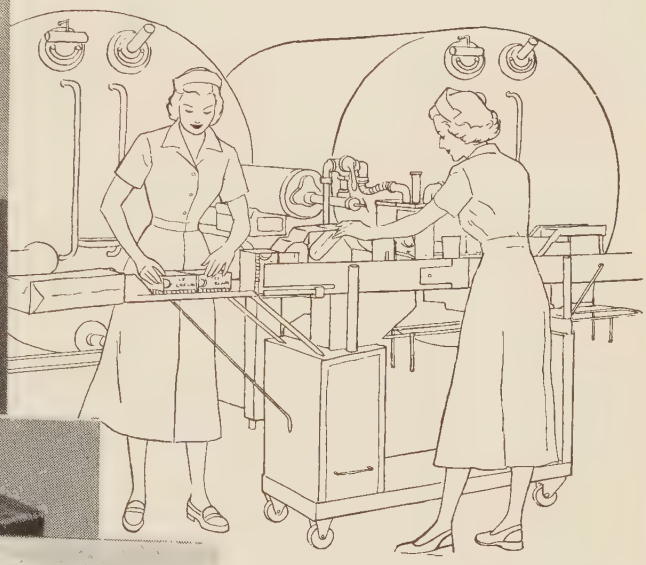

Packaged ice creams are today's biggest sellers. And low-cost waxed cartons make them possible

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- ☐ Barrel linings
- ☐ Bread wrappers
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- ☐ Butcher's paper
- ☐ Candles
- ☐ Candy wrappers
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- ☐ Cartons, frozen food
- ☐ Cartons, ice cream
- ☐ Chewing gum
- ☐ Crayons
- ☐ Drinking cups
- ☐ Electric insulation coating
- ☐ Fabric sizing
- ☐ Fiber plates
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Three people are most interested in the quality of waxed paper products you turn out: you, your customer, and your competitor. And chances are, they'll all know it if you use anything but the one right wax for the job.

That's why your product can stand a better chance for success when you choose your wax from the broad Atlantic line. Because Atlantic waxes are fully refined waxes—available in a wide range of hardnesses and melting points. They're thoroughly diversified, and one of them is just right for your needs . . . to give you the exact results you want, and the greatest real economy.

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DORRCO DOINGS IN 1953

The story of the blind men and the elephant is recalled by today's outlook. One sees only the military strength behind the Iron Curtain, greatly enhanced by the free world's blindness, and feels we should expect hell to come the next minute.

Another, thinking back a few years, sees now great advances in so many areas—no actual fighting in Korea, great physical and moral strength in our European allies, and evidences of internal breakdown in East Germany and other areas behind the Iron Curtain.

We feel that education must be permeating slowly and that in time a reaction will take place. To those of us who are impatient I would recommend Henry Field's fascinating "The Track of Man" to learn how many of our problems reach back 5000 years.

* * *

NEW DEVELOPMENTS — Collaborating with our Associates in Holland, we have developed the application of the TM Dorr-Clone to the starch industry on a commercial scale. This new unit is also proving broadly successful in filtrate clarification and fine sizing of materials in the 2 to 20 micron range.

The Aldrich System, consisting of an annular sand filter combined with a mechanical pre-treatment unit, provides complete water purification in a single machine. A new method of sludge thickening has been developed for sewage treatment which substantially reduces digestion capacity requirements.

As a result of continuing efforts to increase the efficiency of the Dorr Continuous Recausticizing System, the Dorrco White Liquor Polishing Station was added to our line in 1953. It further clarifies the effluent of the White Liquor Clarifier by removing colloidal material which cannot be handled by gravity separation.

WATER TREATMENT — Two 200 ft. pre-sedimentation Thickeners were installed at Kansas City, Missouri, to remove turbidity from Missouri River water prior to conventional purification steps, and Dorrco Flocculators and Monorakes helped provide Dayton, Ohio with an economical new 96 MGD treatment plant. The trend first mentioned in 1952 of the mechanization of plants serving small communities continued again last year.

SEWAGE AND INDUSTRIAL WASTE — Pennsylvania's Clean Streams Program brought for Easton and Bethlehem two outstanding new sewage treatment plants employing Biofiltration and Multdigestion. The world's largest Biofiltration plant, now under construction at Beaumont, Texas, will incorporate four 195 ft. dia. Dorrco Distributors. A large Dorrco d-i System was ordered to clean up a copper, nickel and chrome plating waste for one of America's largest automobile producers.

METALLURGICAL — At the Robena Mine of U. S. Steel Corporation's Coal Division, a 6″ dia. DorrClone, equipped with the new Type CB abrasion resistant liner, showed only negligible wear after over 2300 operating hours on the line. On the Mesabi Range, the Dorr 4-Arm Torq Thickener found extensive application handling taconite mill tailings during the year, and noteworthy metallurgical orders included 16 HX Classifiers and 20 DorrClones for closed circuit grinding of copper ore and acid proof rake Classifiers for washing sandy pulp in a uranium extraction plant.

FERTILIZER PLANT DESIGN — Evidence of continued interest in the fertilizer field is the design of a phosphoric acid plant for Norway and an ammonium phosphate plant for Japan. Engineering initiated in 1952 was completed on a triple superphosphate plant in Florida for The Davison Chemical Corp., and work continued on a large concentrated mixed granulated fertilizer plant for Missouri Farmers Association. Both of these plants will go into operation in 1954.

ABROAD — Once again our Associates overseas have had a very prosperous year. A marked increase has been noted in the number of South American and Near Eastern projects handled by our European companies, and. to facilitate delivery, we have instituted local manufacture of our equipment in Brazil. Among the many installations put into operation or under construction this year were a sewage treatment plant in India, a cyanide plant in Yugoslavia, two FluoSolids Systems to roast pyrite in South Africa, and a project involving the FluoSolids treatment and leaching of a copper-zinc concentrate in Japan.

FLUOSOLIDS — Two FluoSolids Systems went into operation in the United States alone in 1953 producing SO_2 gas for the manufacture of a daily total of 600 tons of sulfuric acid by the contact process. FluoSolids Systems were in operation or under construction by the end of the year for sulfite paper mills with a total capacity of three-quarters of a million tons of pulp per year; the roasting of zinc concentrates and subsequent electrowinning or retort smelting of about 100,000 tons of metal annually; the roasting of gold ores for the cyanide recovery of almost 25 million dollars worth of gold per year; and sulfuric acid plants with an annual capacity of about one million tons of acid. Our work on fundamentals has continued and many new applications of FluoSolids and FluoDry show great promise.

* * *

'53 has been a year of change for us, worse in anticipation than realization. It has brought our New York home and office within two blocks of each other, and of the Chemists' Club, as well as also close to Grand Central trains to Connecticut. Our Westport home has seen grand and great-grandchildren visiting, a great Spring flood and a drought in late Summer with a reparation-conscious bulldozer used to catch a 12″ trout. The latter may have inspired a fishing trip airborne a hundred and fifty miles north of the Saguenay.

The year has been generally one of closing ranks, better production facilities in Denver and Orillia, and continued improvement in internal operations. Major executive changes, consistent with our retirement plan, have gone through smoothly.

Many visitors from our European staff have been welcomed, and one executive from Amsterdam is here taking the Advanced Management Course at Harvard.

We are preparing for our 50th Anniversary of the invention of the Dorr Classifier in July 1954.

Wherever they are scattered, Dorrco staff, I know, join in good wishes to all friends worldwide.

Barry Place, Stamford, Conn.

DORRCO

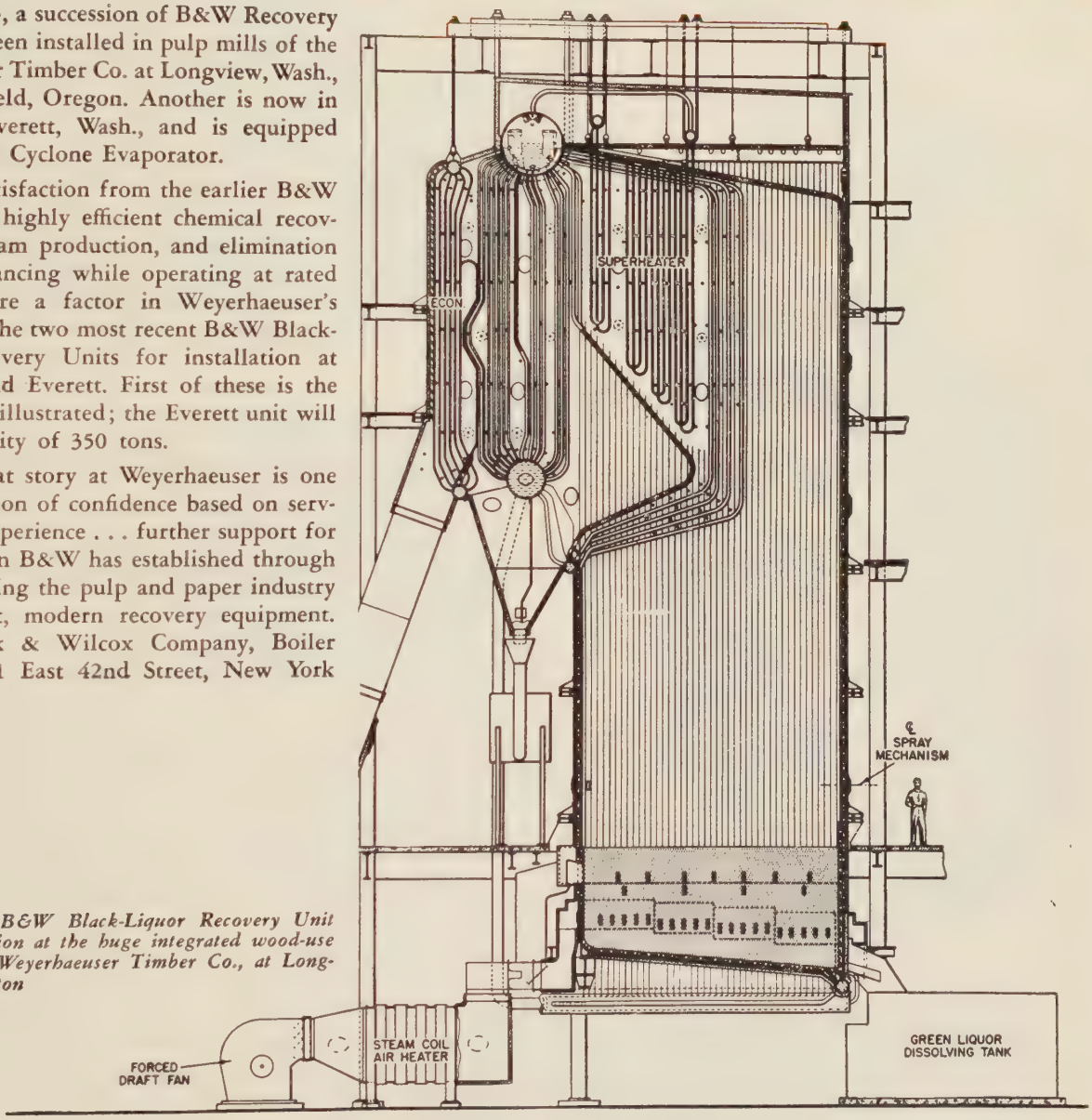
6 B&W RECOVERY UNITS SERVE 3 MILLS OF WEYERHAEUSER

PULP DIVISION

Since 1945, a succession of B&W Recovery Units have been installed in pulp mills of the Weyerhaeuser Timber Co. at Longview, Wash., and Springfield, Oregon. Another is now in service at Everett, Wash., and is equipped with a B&W Cyclone Evaporator.

Service satisfaction from the earlier B&W Units—their highly efficient chemical recovery, high steam production, and elimination of routine lancing while operating at rated capacity—were a factor in Weyerhaeuser's selection of the two most recent B&W Black-Liquor Recovery Units for installation at Longview and Everett. First of these is the 300-ton unit illustrated; the Everett unit will have a capacity of 350 tons.

This repeat story at Weyerhaeuser is one more indication of confidence based on service-proved experience . . . further support for the reputation B&W has established through years of serving the pulp and paper industry with efficient, modern recovery equipment. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.



New 300-ton B&W Black-Liquor Recovery Unit now in operation at the huge integrated wood-use center of the Weyerhaeuser Timber Co., at Longview, Washington

BABCOCK & WILCOX

Haste need not mean waste!

When paper was made by hand—in small deckles, the way the Chinese made it—papermaking was a slow process. To shake the deckle fast enough resulted in waste of furnish that slopped over and fell onto the floor.

With modern machines, haste does not mean waste, if the machine is equipped with the proper Hamilton felts.

All Hamilton Felts—there are 300 different styles—are woven with plenty of open spaces between threads. The water flows through them almost as rapidly as it can be supplied, under pressure, from gravity headboxes or by suction headboxes.

But the fibers cannot get through. They are caught by the long threads of the nap and removed by the metal shoes that scrape the surface of the felts or washed off by jets of clean water. Then the recovered fibers are returned to the wet end to be used over again.

When your machine is equipped with the correct Hamilton Felts haste will not mean waste. The Hamilton Selling engineer who calls on you will tell you why.

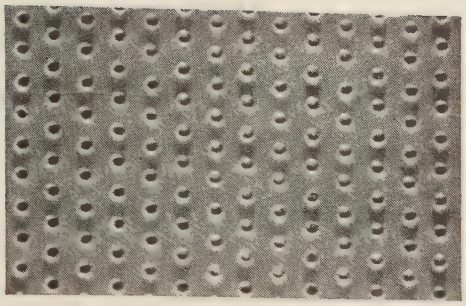
Hamilton Felts

MIAMI WOOLEN MILLS

Established 1858

SHULER & BENNINGHOFEN, HAMILTON, OHIO

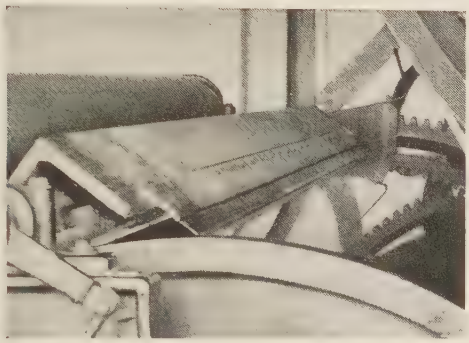
Screen Plates



Efforts to find screen plates with non-enlarging perforations led to trial of thin-gauge Inconel by a Western manufacturer of book groundwood whose plates were corroding beyond use in less than 5 months. This is one of four original plates of .018" Inconel with .045" perforations, photographed after more than 36 months of continuous use. The mill found "no . . . measurable enlargement of the perforations . . ."

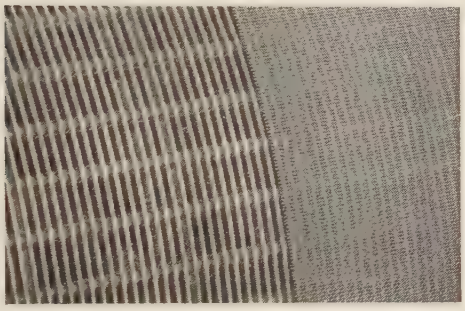
Are replacements costing you TOO MUCH?

Doctor Blades



"K" Monel doctor blades. The mirror-like appearance of the roll itself shows how well the "K" Monel doctor blade on this dryer protects the surface. Even when operated continuously, "K" Monel blades require a minimum of regrinding. Blade surfaces do not rust, and they resist roughening and damage from corrosive paper stocks, sours, cleaners and chemicals.

Winding Wire



Monel winding wire is used over structural rods of cylinders, over drainage strips of drums, and as binding wire over wire cloth faces of filters. Available with a tensile strength as high as 140,000 psi, Monel wire can be wound on its own diameter without fracture. It possesses high resistance to fatigue under corrosive conditions, gives from 2 to 15 times the service obtained from other materials.

You can be sure of this. Frequent replacements always cost too much.

For frequent replacements can be avoided.

You find that out when you use Inco Nickel Alloys like Monel®, "K"® Monel and Inconel®. They last longer (and require less maintenance) because they resist corrosion, abrasion and wear.

And you save money in at least three ways. Here's how you figure it:

On every replacement that you *don't* have to make, your first saving is the *price of materials.* Then you save the entire cost of *labor for installation.* And your third saving is the value of *production ordinarily lost* during downtime.

Count your downtime for honing and grinding doctor blades, too. That has to be done periodically, no matter what blade material you use. But "K" Monel runs longer between regrinds, and helps cut downtime to a minimum.

Inco Nickel Alloys hang up excellent performance records on jobs where many materials find the going rough. You can easily prove this. Just try a replacement part of Monel, "K" Monel or Inconel on machines that are hard hit by corrosion and wear. Then watch how they stand up!

If you'd like advice and help in picking the right metal for any corrosive pulp, paper or board mill job, don't hesitate to call on us. And remember, it is advisable to place equipment orders with your supplier well in advance of scheduled use.

Your local Distributor of Inco Nickel Alloys can give you the latest information on availability from warehouse and mill. We'll be glad to send you his address if you don't have it handy.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys

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Monel® • "R"® Monel • "K"® Monel • "KR"® Monel • "S"® Monel
Inconel® • Inconel "X"® • Inconel "W"® • Incoloy®
Nimonic® Alloys • Nickel • Low Carbon Nickel • Duranickel®

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VANEAXIALS
Mounted in Vertical Exhausts

Roof Installation
of Paper Company Points
Way to Savings in Many Industries

Above are part of the ten 36″ "Buffalo" Type "B" Vaneaxial Fans mounted in roof exhausts of West Virginia Pulp and Paper Co., Mechanicville, N. Y. Note how the fans fit in like a section of pipe. Their light weight obviates heavy, expensive mountings, and the fans waste no space. The steam comes from hoods from Nos. 5 and 6 paper machines—and passes straight through the pipes and fans with absolute minimum resistance. (At right, note how motor is entirely removed from air stream.) Whenever YOU need fans for mounting in straight duct runs, you'll save money with "Buffalo" Vaneaxials.

YOURS! This Helpful Bulletin No. 3533-C! Describes "Buffalo" Axial Flow Fans and their uses. Write for your copy!

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bright, clean, clear shades of very good fastness to light

Uniform shades despite decided fluctuations in tray water pH.

For bond, ledger, index, and cover papers

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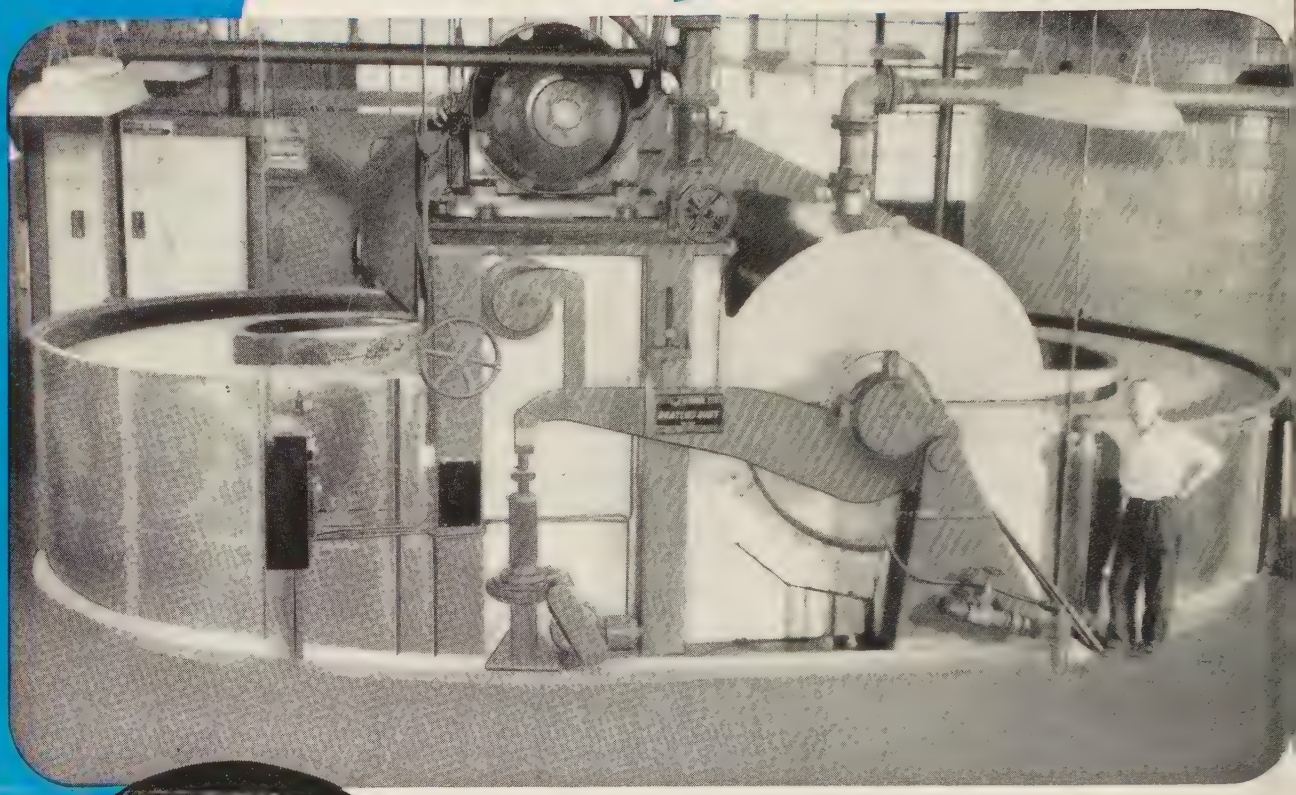
ANOTHER E.D. Jones INSTALLATION



Improved paper formation; 50% saving in horsepower

Results count! And the results on this *Jones Beating Unit*, installed last year at the Taylor Fibre Company, Norristown, Pa., are reported by their Paper Mill Superintendent, C. L. Horst.

"We are able to beat off stock of all grades in the new unit in one half the time it takes to achieve the same results in the old beater . . . a saving in horsepower of 50% per ton of stock.

"As to the cutting action, the actual fibre length is much more uniform, which has had the effect of improved paper formation".

Remarkably simple to install — because it is delivered completely *pre-assembled* — the Jones Beating Unit is available for either tub or Multi-Beater applications. For details, ask your Jones representative, or write us direct.

E.D. Jones

E. D. JONES & SONS COMPANY
PITTSFIELD, MASS.

BUILDERS OF QUALITY STOCK PREPARATION MACHINERY

Variation of Drying Rates of Individual Driers Through the Drier Section

A. E. MONTGOMERY

This is a report on TAPPI financed Project 66 (TAPPI Research Grant no. 21) which, for the first time, provides reliable information on the variation of drying rates through the drier section of paper and board machines under varied conditions, and permits an intelligent determination of the moisture content of the sheet at any point in a proposed machine, and the actual quantitative distribution of evaporation along any drier section. The results of the field tests are presented here in graphical form.

SEVERAL years ago, at the request of the Drying and Ventilating Committee, the Technical Association of the Pulp and Paper Industry appropriated funds to make possible the full-time employment for a brief period of an engineer to visit several paper mills securing drying data to allow study and analysis of the variation in the drying rate as a sheet of paper progresses through a drier section of a paper or board machine. This was set up as TAPPI Project 66 and was supported by TAPPI Research Grant no. 21

Preliminary interim reports were orally presented to TAPPI at an annual meeting in New York and in sectional meetings at Holyoke, Mass., and Appleton, Wis., and before the TAPPI Engineering Conference in Cincinnati, but due to the large amount of work involved in dealing with the great mass of data no member of the committee has previously had the time to draw up a complete formal report. During the past year the Drying and Ventilating Committee* has been successful in preparing this report for publication.

SCOPE OF FIELD WORK

The field work was performed by E. L. Sawyer, who secured data on 40 different drying tests from 35 different machines. These tests covered the following grades:

Three tests on glassine—25 lb. basis weight
Six tests on writing papers ranging from 15–61 lb.
Five tests on tissue and absorbent papers from 9½ to 16 lb. basis weight
Sixteen tests on board (including kraft board) of various classifications from 0.009–30 lb. to 0.048–155-lb. chip
Two tests on book papers
Thirteen on kraft, including kraft board

NEED FOR TESTS AND THE INFORMATION DERIVED FROM THEM

In past years the Drying Committee has published reliable data on the over-all drying rate of paper machines for virtually all classifications of paper, but there has been almost a complete lack of reliable information on the variation in drying rate through the drier section. This information is needed if one must determine at what point in a drier section the sheet is to be expected to reach a given moisture content. Such information is desired for the proper location of a breaker stack, a coating section, or a size press. It is needed for the most intelligent design of a drainage system or a hood exhaust system. It was the purpose of these tests to make available such information.

A common supposition had existed that the drying rate on a paper machine would start out low on the first driers, rise to a maximum, which might be constant through a large section of the machine, and then as the sheet approached dryness the drying rate would drop to a low value, but the point of falling drying rate was not well established.

METHOD OF MAKING TESTS

The main requirement of the tests was to secure accurate moisture samples from the sheet during its progress through the drier section. To do this without interfering with production, or with a minimum interference with production, constituted a problem the solution of which should be of general interest.

With the machine running in a stable, regular manner, machine conditions were noted. Tin cans with airtight covers were used as sample containers to prevent any loss or gain of moisture from the atmosphere. In preparing for a run these numbered cans, with covers loosened, were spotted out at the positions at which it was desired to sample the sheet. Sampling was done from the dry end working toward the wet end. The sampling technique as developed by Mr. Sawyer was different for paper than for board machines.

On paper machines the squirt, with water turned off, was moved in about 8 in. beyond the edge of the sheet and the water was turned on. After the sheet had passed through the presses and felts the cut made by the squirt had rebonded slightly with the main sheet giving the effect of a perforated marking. In the sampling, the backtender reached in, snatched and tore off a section of this strip, handed the section to a second man who tore off the sample from the inner side, dis-

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* The membership of the Drying and Ventilating Committee consists of the following:
Curt A. Young, Riegel Paper Corp., Chairman
R. M. Cook, Midwest-Fulton Machine Co., Secretary
M. L. Barker, Beckett Paper Corp.
A. Cirrito, Lukens Steel Co.
E. G. Drew, Drew Engineering Co.
L. G. Janett, J. O. Ross Engineering Corp.
J. M. McAlear, Mason-Nielan Regulator Co.

carding the deckle edge, and inserted it quickly into the tin can. Working with this method it proved possible to sample a machine at a speed, in one test, of 1150 f.p.m. without a break.

In the case of board, starting near the dry end one man made a knife cut on the drier being sampled beginning at a point about 2 in. from the edge and swinging in a semicircular arc. Another man, standing between this drier and the next, reached in and tore off the sample, handed it to a third waiting person who tore off a section from the inner side, rejecting the deckle edge, wadded the sample, and thrust it into a can, immediately fitting on the lid. Only from 5 to 10 sec. elapsed from the taking of the sample to the time of sealing it in the can. Sampling an entire machine, when properly done, took less than 5 min. At the wet end the paper was cut with a disk cutter or torn from the edge of the sheet. All sampling on board machines resulted in breaking down the sheet, and about 15 min. time was lost on each actual test.

Moisture was determined by drying in the usual manner, all weighings being done with tight covers remaining on the cans. It is believed that this affords as reliable a testing procedure as can reasonably be conceived.

On most machines samples were taken only from every second drier, or even less frequently, the resulting data, when plotted, giving adequately accurate information.

On most machines temperature readings were taken on a sufficient number of drier cylinders to permit plotting a surface temperature curve. In some tests interesting data were secured by obtaining temperature readings also on the sheet of paper or board just before it left the drier cylinder. This is particularly applicable on the board machines and yields interesting and valuable information. All such temperature readings were taken by means of a Cambridge surface pyrometer.

CHARACTER OF DATA OBTAINED

A sketch was prepared on each machine showing the general arrangement of the driers and felt driers and the arrangement of the drier felts. In addition the following data were tabulated:

A. Data on machine.
   1. Number and diameter of paper driers. (The number on machines tested ranged from 10 up to 141.)
   2. Number and diameter of felt driers. (This ranged from 0 to 18, and the ratio of felt drier surface to paper surface ranged up to 26% of the total surface.)
   3. Face width. (This ranged from 80 to 232 in.)
   4. Drainage. (Considered good, fair, or poor.)
   5. Character of hooding. Psychrometric readings were taken in many cases using a sling psychrometer.
   6. Air system on driers or felts.
   7. Condition of drier surface.
   8. Special remarks about factors such as felt wetness, tautness of sheet, etc.

B. Paper data.
   1. Classification.
   2. Basis weight.
   3. Ream size.
   4. Speed of machine. For machines tested this ranged as follows:

Glassine	280 to 500 f.p.m.
Writing	52 to 207 f.p.m.
Tissue and absorbent	290 to 950 f.p.m.
Board	70 to 620 f.p.m.
Book	595 to 810 f.p.m.
Kraft	212 to 1150 f.p.m.

   5. Steam pressure.
   6. Steam temperature.
   7. Moisture in sheet entering driers, expressed as per cent dryness. This ranged as follows:

Glassine	from 19.5 to 23.3—average = 21.6%
Writing	from 33.2 to 39.7—average = 37.9%
Tissue	from 27.6 to 34.8—average = 30.9%
Board	from 29.2 to 37.8—average = 32.8%

(These figures are lower than for the average board machine. The drying rate report in 1939 showed an average for 102 tests reported as about 35.8%.)

Book	from 33.7 to 34.7—average = 34.2%
Kraft	from 25.7 to 33.5—average = 29.9%

   8. Dryness leaving the last drier, expressed as per cent of water.

Glassine	from 3.8 to 6.1—average = 4.7%
Writing	from 1.6 to 3.5—average = 2.7%
Tissue	from 2.7 to 5.0—average = 3.8%
Board	from 0.9 to 7.5—average = 3.6%
Kraft	from 1.1 to 6.4—average = 2.9%

DRYING RATES

The essential drying rate data are tabulated in Table I, paper machine drying rate being calculated in accordance with TAPPI Standard E 203 p-49 and TAPPI Data Sheet 155. An explanation of how the drying rates are calculated for 5% final moisture is given later.

INTERPRETATION OF MOISTURE DATA

All tests were originally plotted on profile paper using the drier numbers, calling the first wet-end drier no. 1, along the abscissa, and temperatures and per cent moisture on the wet basis as ordinates. Representative test data plotted in this manner are shown in the accompanying charts for tests nos. 5, 11, 12, 13, 17, 22, 23, 32 and 36.

It is obvious that data plotted like this do not permit direct comparison of one machine with another on a similar grade of paper, nor does the slope of the curve indicate the relative drying rate of the sheet at different positions in a given drier section. The reason for this is that the change of moisture content when figured on the usual wet basis is meaningless because the basis itself is continually changing as the sheet becomes progressively drier. These objections are overcome on the adjoining graphs of each test where the data are plotted with the percentage of the total number of paper driers (felt driers not counted) as the abscissa and with moisture calculated on the dry basis, that is expressed as the weight of moisture in the sheet divided by the moisture-free weight of the same sheet or sample.

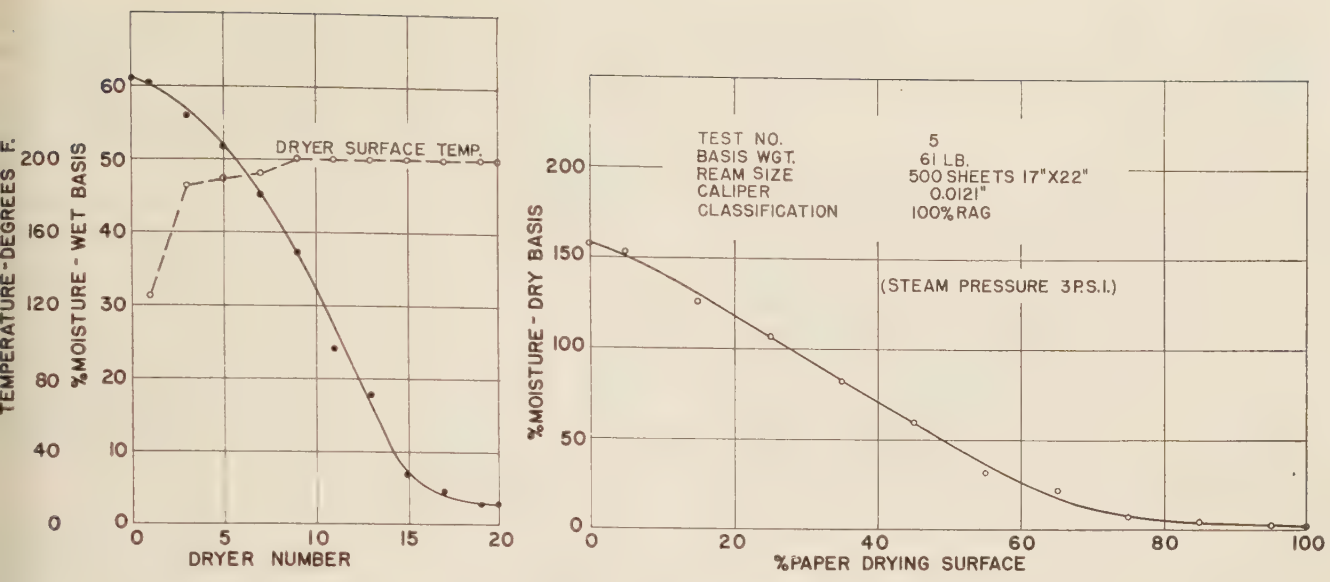
Whereas the slope of the drying curve with moisture plotted on the wet basis is meaningless, the slope of the curve with moisture content plotted on the dry basis is a direct indication of the drying rate. Putting it in other words, the steeper the slope of the line the more rapid the drying. The drying data on any machine can be compared directly with that on any other machine when plotted in this way.

COMMENTS ON INDIVIDUAL TESTS

Test No. 5

This test was on a small machine for writing paper having twenty 48-in. paper driers and no felt driers. Machine speed was 52 f.p.m. with 3 p.s.i. steam pressure. Single asbestos felts were used on top and bottom and were damp.

Very little water evaporation took place on the first drier, the surface temperature of which was only 125°F. Note that the drier surface temperature, as measured



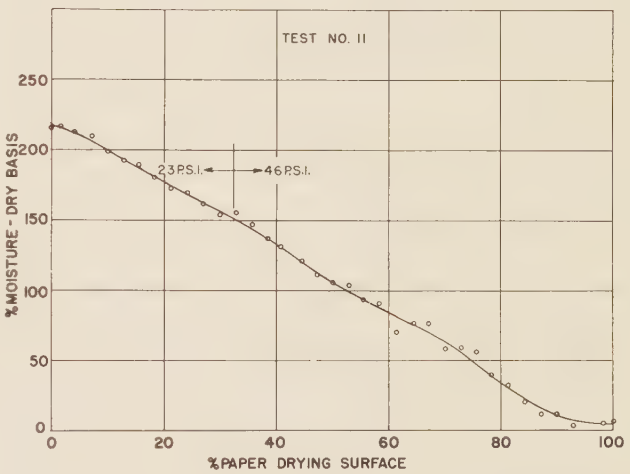
Test no. 5—writing paper

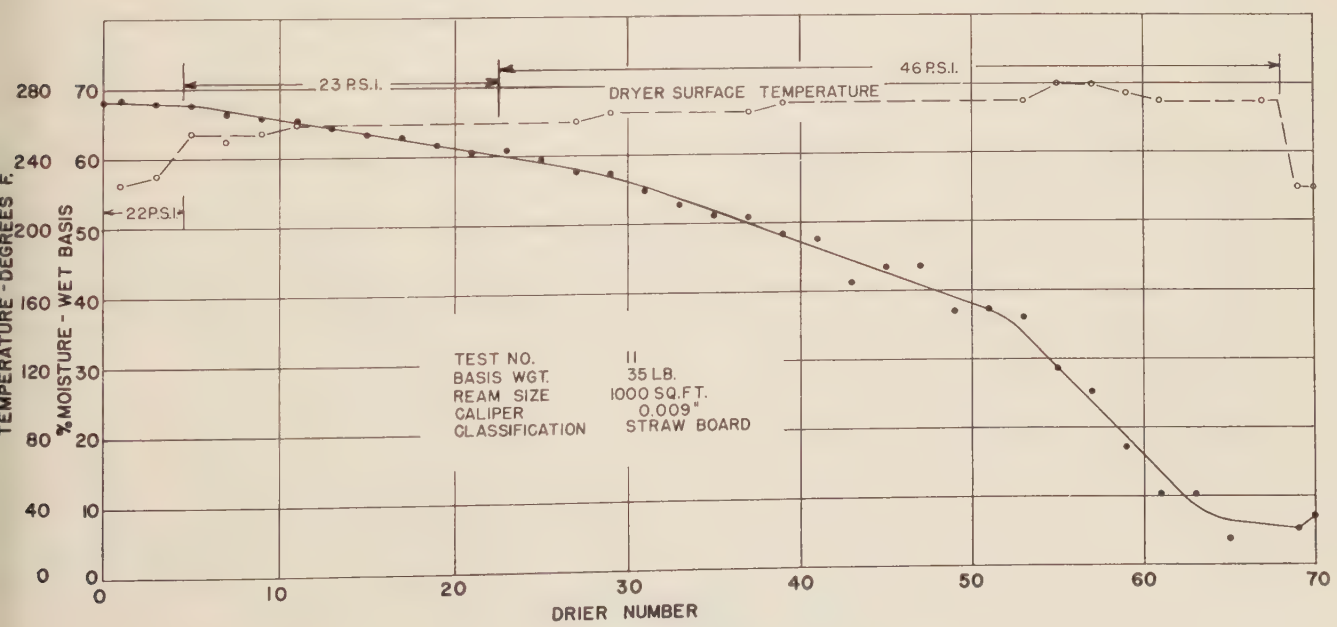
by the surface pyrometer, did not exceed 200°F. (The low machine speed would account for lower readings at the same temperature than would be obtained on a higher speed machine.)

Note that the sheet was down to 5% moisture leaving drier 16, with four driers yet to go.

The drying rate was low on the first drier but then remained substantially constant through drier 13, or 65% of the passage through the machine, at which point the moisture content was about 15%, after which the rate of drying decreased and on the last four driers was very low.

The over-all evaporative drying rate was below average, but calculation shows only 80% of the total drying surface was used in reducing the moisture content to 5% and hence if only this 80% of the drying surface be considered the evaporative drying rate is average. Incidentally it also means that if the machine speed had been increased to permit drying only to 5% moisture on the last drier, and if we assume the enter-





Test no. 11—strawboard

ing moisture content remaining unchanged, the driers could have dried 25% more paper at the same steam pressure.

Test No. 11

This is a valuable test because moisture samples were obtained from every second drier through the entire drier nest of 70 driers. The machine was running at 480 f.p.m. on 0.009-in. strawboard with a weight of 35 lb. per 1000 sq. ft. A top drier felt extended over the first 11 top driers, and had two 48-in. felt driers on the return. Steam pressures were as follows: 22 p.s.i. on first four driers, 23 p.s.i. on the next 18 driers, and 46 p.s.i. on the remaining 48 driers. Strangely, the measured drier surface temperatures do not reflect the considerable increase in steam pressure after drier 22 as one would expect it should.

Driers 1 to 11 were reported as rough, the remainder being smooth and clean. Vapor absorption air was used through the entire drier nest. It is notable that the evaporation drying rate follows almost exactly a straight line, representing a constant drying rate through 75% of the driers, or, that is, to the fifty-first drier, at which point the sheet has about 37% moisture. For the next 11 driers the drying rate is at a constant higher rate perhaps due in part of the higher steam pressure and part to a better sheet contact due to sheet shrinkage. At this point the sheet has about $12^1/_2$% moisture after which the drying rate rapidly diminishes.

The evaporative drying rate, R_w, is average for board at the given steam pressure.

Test No. 12

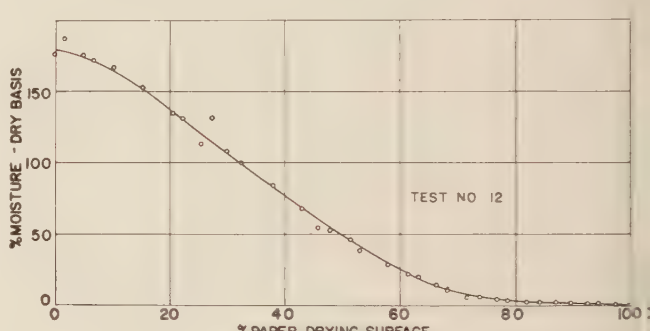
This is an especially interesting test as showing what can occur when a sheet is seriously overdried. The board machine had 117 driers, 48-in. diameter arranged in three decks. A vapor absorption system was used. The first drier was heavily coated with tar and driers 1 to 18 were rough, the remainder being smooth and clean. The drier steam pressure was substantially constant throughout the entire machine, actually being 22 p.s.i. on the first three driers, 20 p.s.i. on the following 23 driers, and 18 p.s.i. on the final 91 driers. The board was 0.018-in. white patent coated.

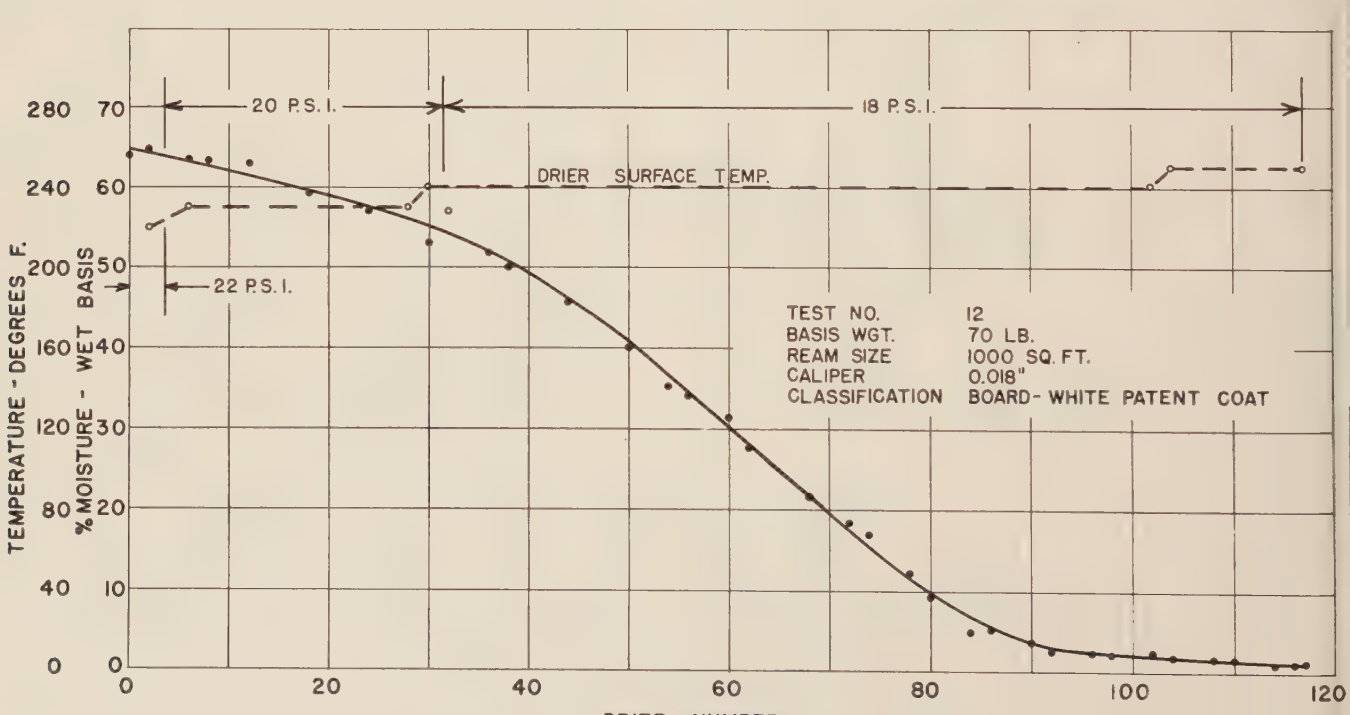
The drier surface temperatures were remarkably constant on the relatively few driers measured by the surface pyrometer.

Reference to the curve of per cent moisture on a dry basis discloses that the drying rate is low for approximately the first eight driers after which it becomes reasonably constant to the sixtieth drier (52% of the way through the drier section) after which the drying rate drops off more and more, and after drier 88 for the remaining 29 driers the drying rate is extremely low.

It may be noted that the first break in the drying rate, at about the sixtieth drier, occurs when the sheet has 30% moisture (wet basis), but that the more marked decrease in drying rate occurs after the sheet has been dried to 15% moisture.

It is especially notable that on this machine the board has been reduced to a moisture content of 5% on drier 85, with 32 driers yet to go, all having 22 p.s.i. steam pressure. The over-all drying rate, R_p, for this





Test no. 12—white patent coated board

machine is 0.70 (poor), whereas the over-all drying rate up to the point where the sheet has 5% moisture is 0.96 (average). If the entering moisture content and other factors affecting drying rate would have remained unchanged with increase in speed, this machine actually could have dried 37% more paper with the same steam pressure if drying only to 5% final moisture content.

Calculation discloses that the first 85 driers on the average evaporated fifteen times as much water as did the average of the last 32 driers.

Test No. 13

This is a good representative test on a large board machine drying 0.048-in. chip board having a basis weight of 155 lb. per 1000 sq. ft. The machine had one hundred and twenty-four 48-in. diameter driers, the first 14 being arranged in two deck and the balance in three deck. Steam pressures were as follows: 20 p.s.i. on first five driers, 43 p.s.i. on next nine driers, 40 p.s.i. on following 27 driers, with 18 p.s.i. on the remaining 83 driers.

Comments were made that the driers 1 and 2 were coated with tar, driers 1 through 23 had rough surface, the remainder being smooth and clean. A vapor absorption air system was used. The evaporative drying rate 1.50 and the production drying rate of 0.78 are both poor. The data available do not disclose why this should be so. The final moisture content is 6%—favorable.

Only a few drier surface temperatures were taken, but it is evident that for most of the machine the drier surface temperature was 270 to 280°F. One low-temperature (inactive) drier was discovered, and doubtless there were more.

The drying rate curve plotted against moisture on the dry basis appears to indicate an improvement in the drying rate at a point about 30% through the machine (about the thirty-seventh drier) quite likely due to the natural shrinkage in the sheet or a change perhaps in draw causing better sheet contact with the driers.

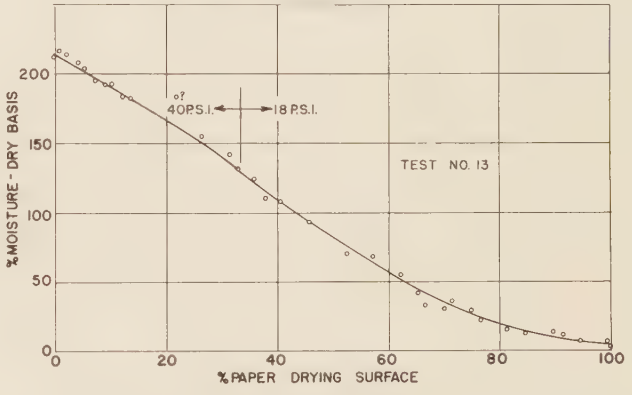
There is no sharp point at which the drying rate appears to drop off, but it is starting to drop off at a point 68% through the drier section (the eighty-fourth drier) at which point the sheet has 28% moisture on the wet basis. The decrease in drying rate accelerates from that point continually to the end of the drier section.

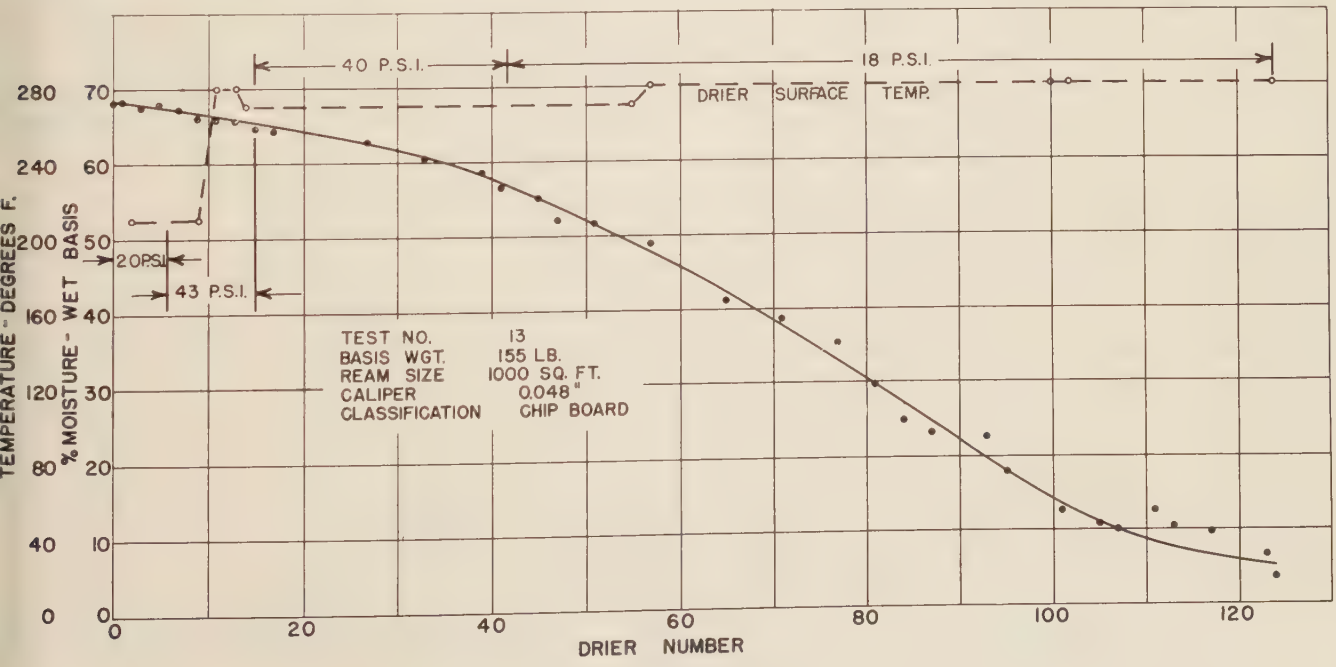
Test No. 17

This is the first test in which an attempt was made to secure sheet temperatures with the surface pyrometer as well as drier surface temperatures. All data are shown on the graph. The machine has 141 driers 42-in. diameter, all arranged in vertical stack, four high, except for the last 13 driers which are in a three-deck section. The machine was running at 185 f.p.m. The note is made that all driers were coated and rough. Unfortunately the steam pressure is not given.

Basis weight	138 lb.
Ream size	1000 sq ft.
Caliper	0.034 in.
Classification	Board: clay coated, jute lined, kraft back

The sawtooth effect in the curve of sheet temperature shows the cooling which takes place in the sheet as it



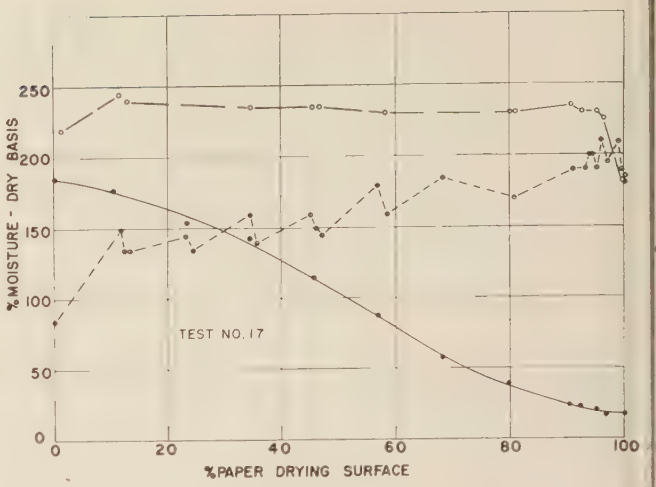


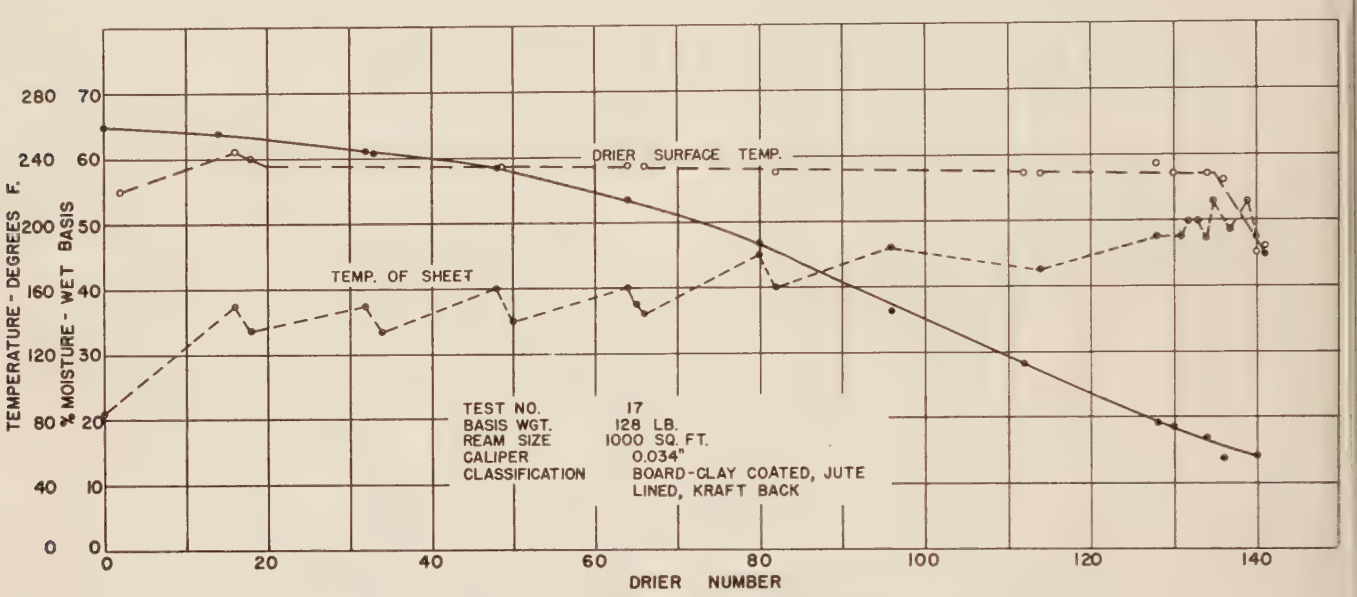
Test no. 13—chip board

made the long pass at the bottom from one stack to the next. In passing it may be noted that this drop in temperature is not necessarily detrimental, for drying takes place during this interval, the heat for drying being supplied by the sensible heat in the sheet itself.

It is notable also that in this test the sheet was taken off the driers with 14.5% final moisture content on the wet basis.

It will be noted, as in test no. 13, that the drying rate improves when the sheet is about one third through the drier section and that it starts to decline when the sheet has about 36% moisture content on the wet basis. Due to the few moisture samples taken at this point, and the resultant possibility of an error in one of them, it is not possible to fix the exact point at which the decline in drying rate occurs.

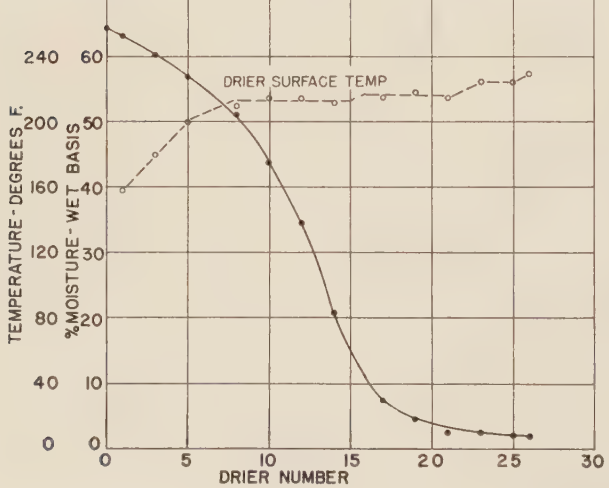


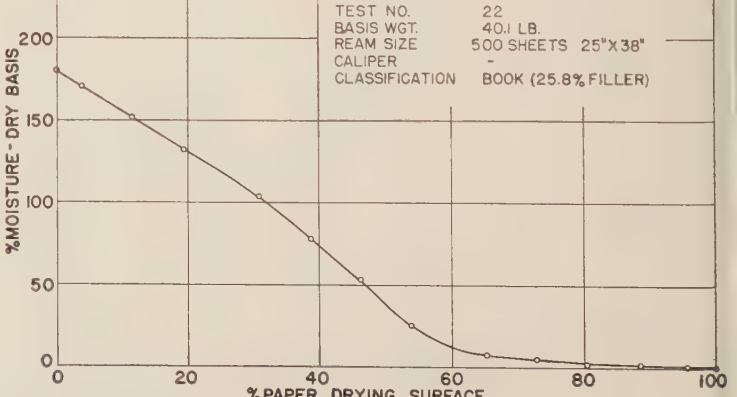


Test no. 17—clay coated board, jute lined, kraft back

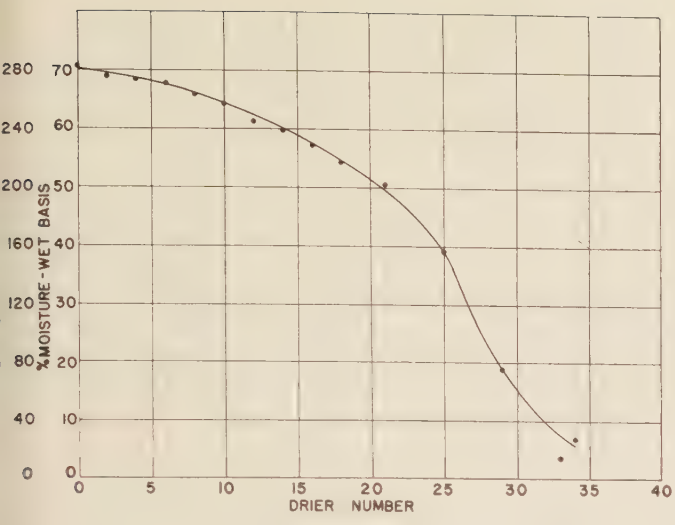
Test No. 22

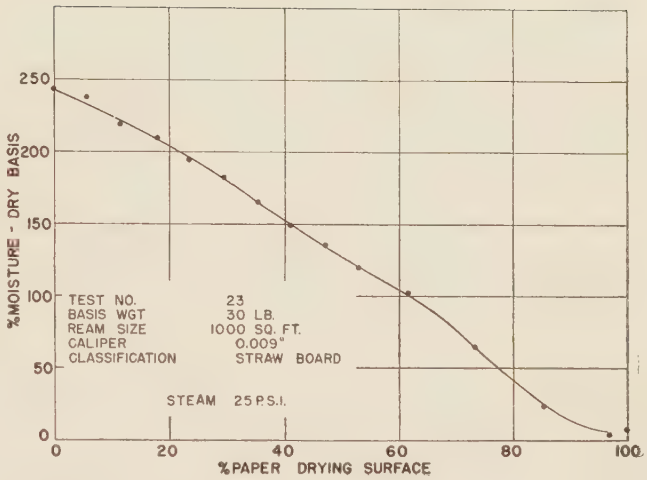
Test no. 22 shows a book paper machine on which the paper was considerably overdried. The machine had twenty-seven 60-in. paper driers and two 48-in. felt driers, one top and one bottom. All driers were clean and smooth. The sheet was 40 lb. basis weight for supercalendering, and it is hard to see why the sheet should have been made so dry for that purpose. The sheet was down to 4.5% moisture content leaving the nineteenth drier, and the remaining seven driers reduced the moisture content to 2.0%.





Test no. 22—book





Test no. 23—strawboard

Test No. 23

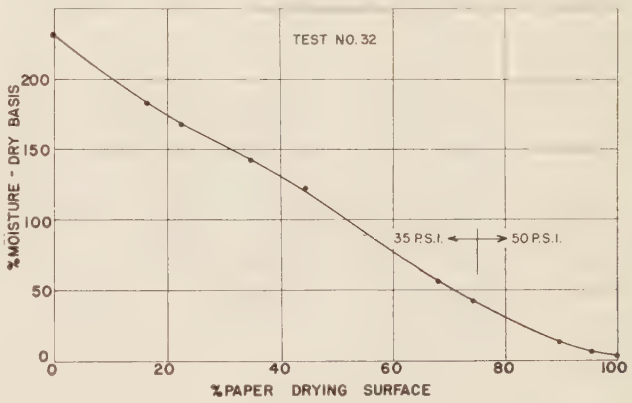
This test was on a straw paper machine having 34 riers, 36-in. diameter, arranged in two deck, but the rst drier was out of service and the twentieth drier as used as a felt drier for the only drier felt which as a bottom felt under the dry end driers. The achine produced 0.009-in. strawboard and ran at 90 f.p.m. with about 25 p.s.i. steam pressure. The dication here is that the machine retained the maxium drying rate to a point where the sheet moisture ad been reduced to about 19% on the wet basis.

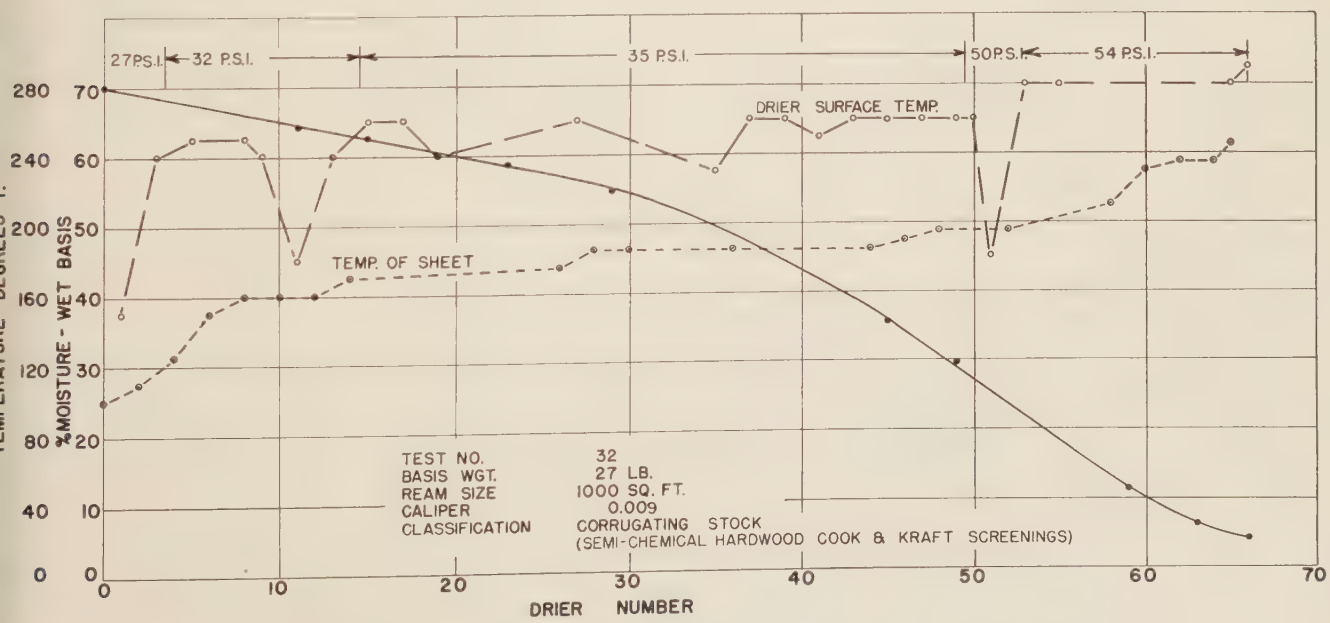
Test No. 32

This is an interesting test on a two-deck board achine having 66 driers, 48-in. diameter, making .009-in. corrugating stock from semichemical hardood pulp and kraft screenings. The sheet was said o have a high liquor content making it hygroscopic. The driers were rough but clean. Steam pressure was s follows: driers 1 to 3, 27 p.s.i.; driers 4 to 15, 32 p.s.i.; driers 16 to 49, 35 p.s.i.; driers 50 to 53, 50 p.s.i.; driers 54 to 56, 54 p.s.i.

The drying rate was continued high to the very last drier, with no evident loss of production due to overdrying.

The drier sheet temperatures were recorded as well





Test no. 32—corrugating stock

as some of the drier surface temperatures. It is evident there were a number of driers with poor drainage, and the result of these can be seen in the sheet temperature curve as well as in the recorded drier temperatures.

The drying rate, as plotted with moisture content on the dry basis, shows as a surprisingly straight line for the first three quarters of the drying length and only begins to drop off slightly at this point with the moisture content on the wet basis being 30%. Even after that the drying rate is well maintained until the moisture content is down to about 11 to 12%, after which it diminishes rapidly.

Test No. 36

This test is on a large, high-speed, fourdrinier kraft paper machine having 52 paper driers and eight felt driers, all 60-in. diameter, running at 1100 f.p.m. making 42-lb. kraft bag paper. Steam pressure was 38 p.s.i.

It is evident that the drying rate was essentially uniform from the first drier on through the machine until the point of falling drying rate obtained. Not enough moisture samples were taken to give a sharply defined breaking point in the drying rate but evidently it occurs on this machine about 20% moisture content on the wet basis.

The effect of over drying on this machine is clearly shown. The sheet reaches 5% moisture content at about drier 42, and the remaining ten driers were used in reducing the moisture content down to 1.8%. The indication, therefore, is that had the machine been speeded up to a point that the sheet would leave the driers at 5% moisture it could have run 24% faster.

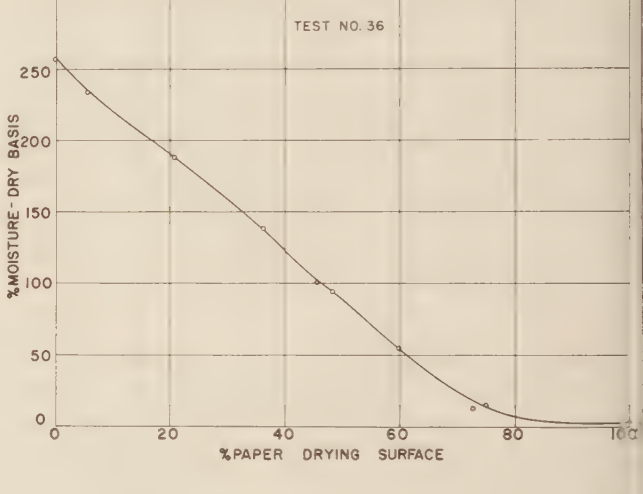
Mr. Sawyer reported that it was very enlightening to this mill to find that their routine tests had been deceptive. Moisture tests were taken continually from every roll of paper, but in the technique used the paper picked up considerable moisture after leaving the last drier and in sampling. The testing technique used b Mr. Sawyer was more accurate. They had not know they were overdrying until these tests were made, an they stated that the value of the tests in their mill i this one respect was worth a great deal to them.

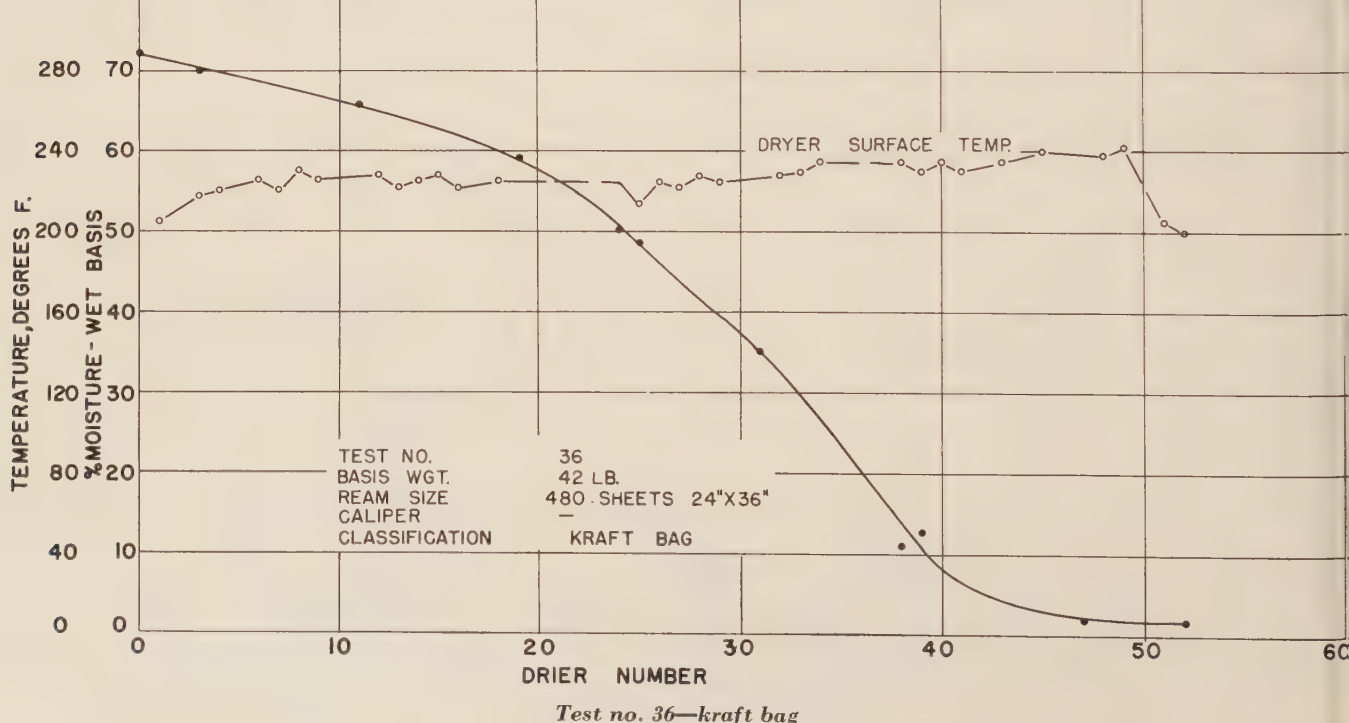
COLLECTED TESTS BY PAPER CLASSIFICATION

As previously stated, the data from any number o machines can be reduced to a form permitting direc comparison by plotting per cent moisture on the dr basis against per cent of paper drying surface. Th data on several paper classifications have been plotte in this way and the information so obtained prove particularly enlightening.

Glassine

The first three tests were made on machines produc ing glassine paper, and these are shown in Fig. 1. Test nos. 1 and 2 were both made on the same machine, o





Test no. 36—kraft bag

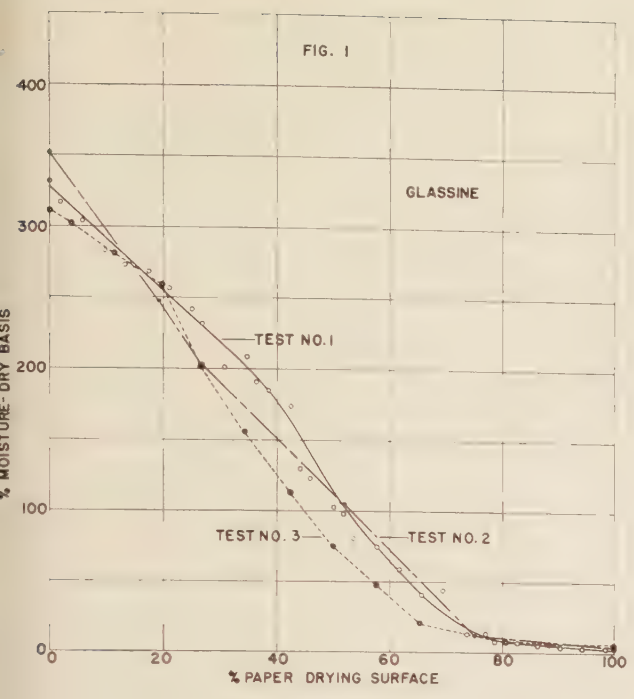


Fig. 1. Glassine

eparate days, but running the same weight of paper. This machine has 52 paper driers, 36-in. diameter, and 18 felt driers, also 36-in. diameter. The basis weight was 25 lb. (24 × 36—500). In test no. 1 the machine was running 500 f.p.m., and in test no. 2, 410 f.p.m., with about 5 p.s.i. steam pressure in both cases.

The testing technique had not been perfected in test no. 1, and there seems to be evidence that a change in the drying conditions occurred midway in the test, for the drying rate curve is reasonably straight both preceeding and following this apparent break. Many samples were taken, precluding the possibility of sampling errors affecting the trend of the drying curve.

In test no. 2 fewer samples were taken, as is indicated in the plotted data.

Test no. 3 was on a different machine having only 26 paper driers 48-in. diameter and seven felt driers. This machine ran 280 f.p.m. with about 3 p.s.i. steam pressure. The note was made that the drainage was poor, the condensate pump being too small. This may perhaps account for the low drying rate at the wet end.

The drying rate appears to begin to fall off earlier on this machine. We do not know why this should be so. It was noted that the drier felts were wet at the dry end. The drier surface temperature on the last half of the machine was about 10 or 15° lower than on the machine shown in tests nos. 1 and 2. Strangely, the over-all drying rate, both R_p and R_w, was materially higher on test no. 3 than for the machines shown in tests nos. 1 and 2.

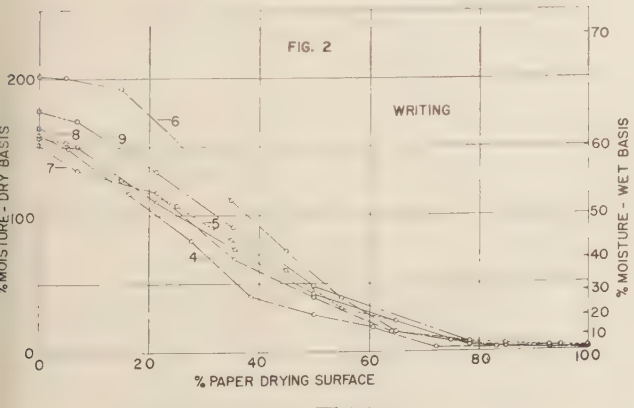


Fig. 2. Writing

Writing Papers

Figure 2 shows a family of drying curves on six different paper machines making writing papers. It is a group notable for low steam pressure and no desire for high drying rate. All tests showed very low final moisture content.

Test no. 4 was on a machine making 20-lb. folio, 50% rag paper, having eighteen 48-in. paper and two 48-in. felt driers. The machine ran 207 f.p.m. and had asbestos felts which ran reasonably dry. Good drainage. The dryness going on the first drier was 38.6%. The moisture content was down to 2.6% moisture leaving the twelfth drier with six driers yet to go. Forty-

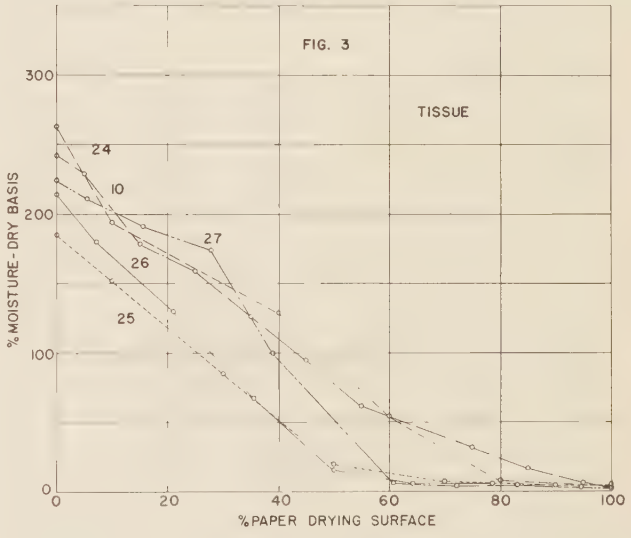


Fig. 3. Tissue

three per cent more drying would have been possible with the same steam pressure if the paper had been taken off the driers with 5% moisture. Drier surface temperatures were taken showing 150°F. on the first drier, 182°F. on the third drier, 210°F. on the fifth drier, thence rising very slowly to 215°F. on the 15th drier.

Test no. 5 was on 61-lb. (17 × 22—500) 100% rag index. The machine had 20 paper driers, 48-in. diameter, with no felt driers, and used asbestos felts which were noted to be damp at the wet end. The machine ran 52 f.p.m. with 3 p.s.i. steam pressure. The sheet was 39% dryness going on the first drier and down to 5% moisture leaving no. 16 drier. The evaporative drying rate, R_w, figures 0.87 (below average) but if figured only for the driers to the point where the sheet had been reduced to 5% moisture, R_w would be 1.05 which is average.

The surface temperature of the driers was taken in test no. 5 and shows 125°F. on drier no. 1; 185°F. on

no. 2; 190°F. on no. 5; no. 7, 192°F.; no. 9 and remaining driers all 200°F.

Test no. 6 was on 20-lb. folio, 100% rag furnish. The machine had 20 driers, 48-in. diameter, and no felt driers. The asbestos felts were stated to be damp at the wet end. The machine ran 155 f.p.m. Steam pressure is not given. The sheet was only 33.2% dryness going on the first drier which is a high entering moisture content for this grade. It reached 5% moisture on the sixteenth drier, with four to go, and was down to 2.2% moisture leaving the twentieth drier. Drier surface temperatures taken on this machine showed 100°F. on the first drier, 120°F. on the third, 200° on the fifth, 205° on the seventh and tenth with temperatures then increasing gradually to 215°F.

Tests nos. 7 and 8 are on machines having the same number and arrangement of driers, and test no. 9 is on a closely similar machine. All are characterized by a high dryness going on the driers, no. 7 showing nearly 40%. The drying rates are about average and would have been better except for the low final moisture content. In each case the comment was made that the wet-end driers were rough, and perhaps this accounts for the low drying rate on the first two or three driers,

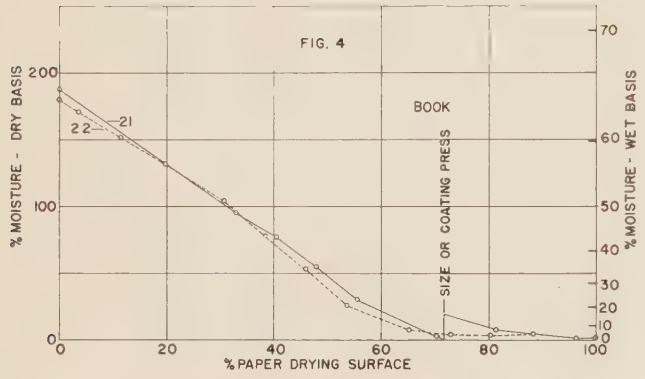


Fig. 4. Book

or perhaps the steam pressure was lower in these. The small number of driers (only 14) causes the plotted drying rate on these to represent a larger percentage of the total drying surface than on longer machines.

The drying rate diminishes gradually on this entire group, with no decided breaking point, becoming definitely noticeable at about 26% moisture on the wet basis (35% on the dry basis). After reaching a point of 9 to 12% dryness the drying rate becomes progressively very low.

Taking the average of these six tests on writing papers the evaporation is performed as follows:

1st 20% of paper driers, 25.5% of evaporation
2nd 20% of paper driers, 35% of evaporation
3rd 20% of paper driers, 26% of evaporation
4th 20% of paper driers, 12% of evaporation
5th 20% of paper driers, 1.5% of evaporation

Tissue

Another family of drying curves are shown on Fig. 3 for five different machines making tissue paper ranging in weight from 9.9 to 16.0 lb. per 3000 sq. ft. No Yankee machines are included. These are interesting for individual study.

Test no. 10 was on 13½-lb. tissue, 85% bleached

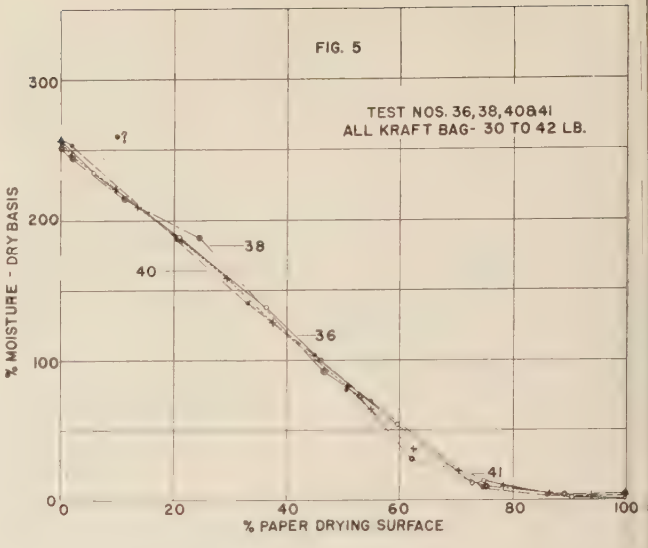


Fig. 5. Kraft bag

sulphite, and 15% groundwood. The machine had 20 paper driers and no felt driers. Starting with no. 11 drier surface temperatures were all 260 to 270°F. except nos. 15 and 17 which were respectively 175 and 205°F. Had it not been for these two cold driers the drying rate at 75 and 85% would presumably have been higher than shown.

Test no. 24 is for a 12-lb., 100% kraft, carpet twisting tissue made on a machine having ten 48-in. driers and no felt driers. The drier surface temperature was 170 to 185°F. on all driers. Only five driers were sampled, which is not enough to permit drawing firm conclusions.

Test no. 25, in the same mill, is on a 16-lb. bleached kraft and bleached sulphite tissue on a machine of the same length and arrangement as the preceding. Drier surface temperatures were 190°F. on the first two driers, then varied from 160 to 170°F. except the ninth which was 180°F. and the last which was 145°F. Here the drying rate appears entirely constant over the first five driers, at which point the moisture content had been reduced to 16.6% on the wet basis (20% on the dry basis). During the remaining 50% of the drying the drying rate was very low. Ninety-one per cent of the water was evaporated on the first half and only 9% on the last half of the driers.

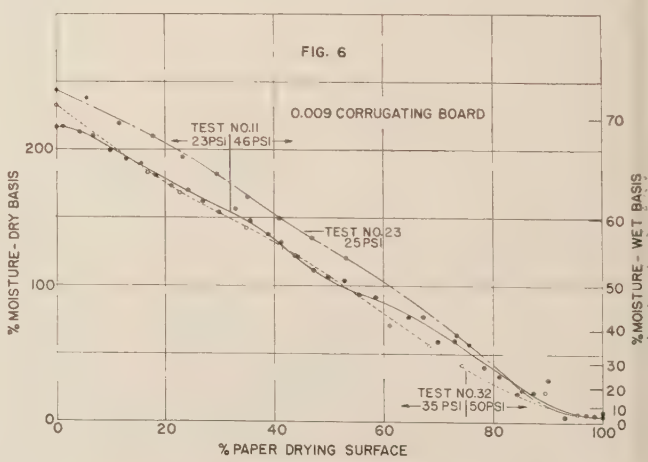


Fig. 6. 9-Pt. corrugating board

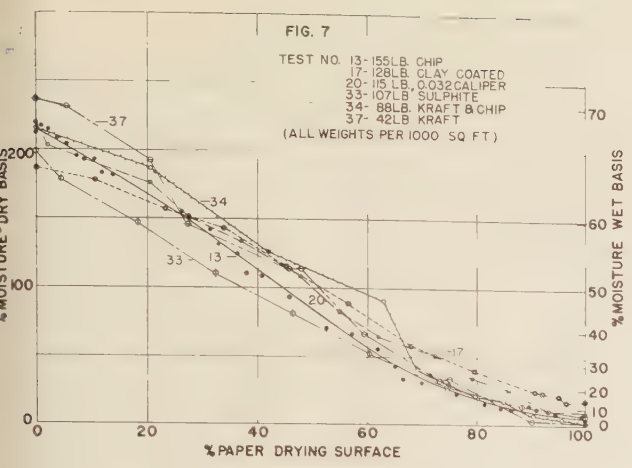


FIG. 7
TEST NO. 13- 155LB. CHIP
17- 128LB. CLAY COATED
20- 115 LB., 0.032 CALIPER
33- 107LB. SULPHITE
34- 88LB. KRAFT & CHIP
37- 42LB. KRAFT
(ALL WEIGHTS PER 1000 SQ. FT.)
% MOISTURE - DRY BASIS
% MOISTURE - WET BASIS
% PAPER DRYING SURFACE

Fig. 7. Board without overdrying

Test no. 26 on a 9.5-lb. bleached kraft sheet run on a machine having fourteen 48-in. driers shows exactly similar results—a constant drying rate on the first seven driers (50% of the total), with the moisture then reduced to 13.5% on the wet basis. Here 95% of the water was evaporated on the first half of the driers, and only 5% on the last half, and again there was almost no drying on the last five driers. Drier surface temperatures taken on this machine were 120 to 150°F. on the first three driers, then 160 to 180°F. on all except the last drier which showed 200°F. It was claimed that poor drainage existed on these machines.

For this group of five tissue machines the average rate of water removal is as follows:

1st 20% of driers, 32% of evaporation
2nd 20% of driers, 30% of evaporation
3rd 20% of driers, 27% of evaporation
4th 20% of driers, 8% of evaporation
5th 20% of driers, 3% of evaporation

Book

Only two tests were secured on book papers, but they are remarkably revealing. These are plotted together in Fig. 4. Both were on 40-lb. basis weight book paper having about 26% filler. Test no. 21 was on a machine having 20 paper driers and 6 felt driers, all 60-in. diameter, ahead of a size or coating press, and 7 paper driers with no felt driers following it. Test no. 22 has already been described, it being notable for the marked overdrying.

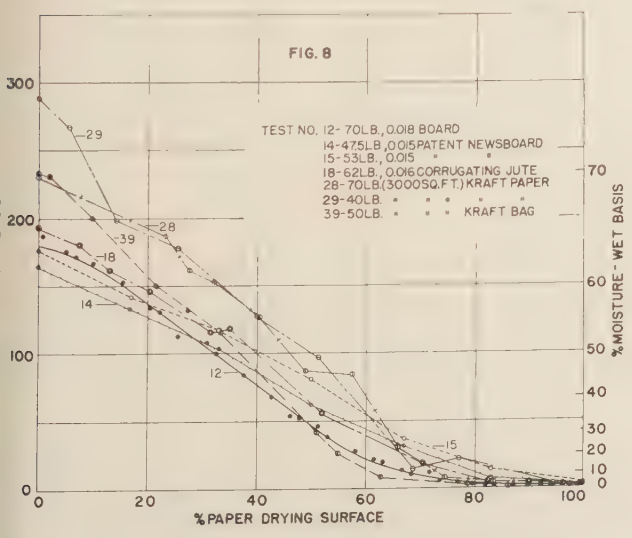


FIG. 8
TEST NO. 12- 70LB., 0.018 BOARD
14- 47.5LB., 0.015 PATENT NEWSBOARD
15- 53LB., 0.015 " "
18- 62LB., 0.016 CORRUGATING JUTE
28- 70LB. (3000 SQ. FT.) KRAFT PAPER
29- 40LB. " " " "
39- 50LB. " " KRAFT BAG
% MOISTURE - DRY BASIS
% MOISTURE - WET BASIS
% PAPER DRYING SURFACE

Fig. 8. Board and paper with overdrying

In both tests the drying rate is remarkably constant to a point where the moisture content is down nearly to 10% on the wet basis. Not enough samples were taken to establish the breaking point exactly, but it is close to this figure. Test no. 22 shows a somewhat lower drying rate on the first one-third of the paper driers, then increased on the following 30%, this doubtless being due to changes in the steam pressure on these sections. The steam pressures were not recorded, but the drier surface temperatures on test no. 22 indicate this to be true. In test no. 21 the surface temperatures are more uniform, ranging from 210°F. at the wet end to 225°F. at the dry end before the size press, and about the same following it.

In test no. 22, with no size or coating press, 73% of the total drying surface was used in drying the paper to 5% moisture content, and 27% in reducing it from 5% to the final 2%, thereby removing only 1.7% of the total water evaporated! Putting it another way, each drier in the last 27% on the average evaporated only 4.7% as much water as the others did.

Kraft Bag

An especially noteworthy family of drying curves are shown in Fig. 5 covering four tests on kraft bag papers, run on high-speed machines. Test no. 36 was run in one mill, and the other three in a mill of another company. Tests 40 and 41 were repeat tests on the same machine on successive days. Test no. 36 has already been described at length.

These tests show a remarkably uniform rate of moisture removal from the first drier to a point where the moisture content is reduced to 23% on the dry basis, or 21% on the wet basis, where it first begins to decrease.

Summarizing the average of these four tests the rate of moisture removal is as follows:

1st 20% of paper driers, 24% of evaporation
2nd 20% of paper driers, 28.5% of evaporation
3rd 20% of paper driers, 29% of evaporation
4th 20% of paper driers, 16.5% of evaporation
5th 20% of paper driers, 2% of evaporation

On the average, these four machines used just 85% of the total drying surface in reducing the moisture content to 5% on the wet basis. With the same drying rate as existed on these first 85% of the driers, these machines could have evaporated 18% more water with the same steam pressure had the paper been dried only to 5% moisture.

9-Point Corrugating Board

Figure 6 shows the group of drying curves for three tests on 9-point corrugating board, these being tests nos. 11, 23, and 32, each of which has already been described individually. These machines were operating normally without evident loss of capacity due to overdrying.

The average of these three tests shows the following variation in the rate of moisture removal through the drier sections:

1st 20% of driers, 20.3% of evaporation
2nd 20% of driers, 20.1% of evaporation

Table I. Drying Rate Data

Test no.	Product	Basis weight, lb.	Ream area, sq. ft.	Weight, 3000 sq. ft. basis	Machine speed, f.p.m.	Steam pressure, av. p.s.i.	Paper driers	Felt driers	S/W Paper driers	S/W Felt driers	S/W Total	R_p	Dryness entering, %
1	Glassine	25.1	3000	25.1	500	5	52—36-in.	18—36-in.	40.8	14.1	54.9	0.33	23.3
2	Glassine	25.0	3000	25.0	410	5	52—36-in.	18—36-in.	40.8	14.1	54.9	0.31	22.1
3	Glassine	25.3	3000	25.3	280	3	26—48-in.	7—48-in.	27.2	7.3	34.5	0.34	19.5
4	Writing—50% rag	20	1299	46.3	207	4	18—48-in.	2—48-in.	18.9	2.1	21.0	0.76	38.6
5	Writing—100% rag	61	1299	141	52	3	20—48-in.	none	20.9	0.0	20.9	0.58	39.0
6	Writing—100% rag	20	1299	46.3	155	....	20—48-in.	none	20.9	0.0	20.9	0.57	33.2
7	Writing—100% rag	32	1299	73.7	77	5	13—48-in.[a]	none	14.4	0.0	14.4	0.66	39.7
8	Writing—50% rag	26	1299	60	137	10	13—48-in.[a]	none	14.4	0.0	14.4	0.95	37.8
9	Writing—50% rag	15	1299	34.6	180	....	14—48-in.	none	14.6	0.0	14.6	0.71	38.2
10	Tissue	13.5	2880	14.1	950	....	20—48-in.	none	20.9	0.0	20.9	1.07	29.1
11	Strawboard—0.009 in.	35	1000	105	480	39	70—48-in.	2—48-in.	73.2	2.1	75.3	1.12	31.9
12	Board—patent coat	70	1000	210	245	18.5	117—48-in.	none	122.4	0.0	122.4	0.70	36.1
13	Board—chip	155	1000	465	130	25	124—48-in.	none	129.9	0.0	129.9	0.78	32.0
14	Board—patent news	47.5	1000	142.5	255	....	96—42-in.	none	87.8	0.0	87.8	0.69	37.8
15	Board—patent news	52.9	1000	158.7	255	....	96—42-in.	none	87.8	0.0	87.8	0.77	36.0
16	Board—patent news	95	1000	285	172	35	87—48-in.	none	91.0	0.0	91.0	0.89	..
17	Board—clay coated	128	1000	384	185	....	141—42-in.	none	129.2	0.0	129.2	0.92	34.7
18	Board—0.016-in. corrugating	62	1000	186	348	36	111—42-in.	none	129.2	0.0	129.2	0.83	34.1
20	Board—0.032-in.	115	1000	345	150	32	87—42-in.	none	79.7	0.0	79.7	1.08	31.2
21	Book	39.9	3299	36.3	810	....	20—60-in.[b]	6—48-in.	26.2	6.3	32.5[b]	1.51[b]	34.7
22	Book	40.1	3299	36.5	595	....	27—60-in.	2—48-in.	35.3	2.1	37.4	0.96	33.7
23	Strawboard—0.009 in.	30	1000	90	190	25	32—36-in.	1—36-in.	25.1	0.8	25.9	1.10	29.2
24	Tissue—kraft	12	2880	12.5	320	....	10—48-in.	none	10.5	0.0	10.5	0.64	27.6
25	Tissue	16	3000	16.0	290	....	10—48-in.	none	10.5	0.0	10.5	0.74	34.8
26	Tissue	9.5	2880	9.9	560	....	44—48-in.	none	14.6	0.0	14.6	0.64	32.0
27	Tissue	12	2880	12.5	440	....	18—42-in.	none	16.5	0.0	16.5	0.56	30.9
28	Kraft	70	3000	70	612	27	36—60-in.[a]	6—48-in.	61.0	6.3	67.3	1.06	30.3
29	Kraft	40	3000	40	730	32	34—60-in.[a]	6—	45.3	4.8	50.1	0.97	25.7
30	Kraft board	32	1000	96	620	35	87— [a]	4—48-in.	96.7	2.2	98.9	1.00	32.3
31	Kraft board	70	1000	210	225	33	108— [a]	none	119.5	0.0	119.5	0.66	31.8
32	Board, 0.009-in. corrugating	27	1000	81	550	39	66—48-in.	none	69.0	0.0	69.0	1.08	30.0
33	Board, sulphite	107	1000	321	70	35	43—42-in.	none	39.4	0.0	39.4	0.95	33.5
34	Board, kraft and chip	88	1000	264	212	29	114—48-in.	none	119.1	0.0	119.1	0.78	31.7
35	Kraft, bag	60	2880	62.6	1100	38	52—60-in.	8—60-in.	67.9	10.5	78.4	1.44	29.9
36	Kraft, bag	42	2880	43.8	1100	38	52—60-in.	8—60-in.	67.9	10.5	78.4	0.85	27.9
37	Kraft, board	42	1000	126	612	45	52—60-in.	8—60-in.	67.9	10.5	78.4	1.64	30.6
38	Kraft, bag	29	2880	30.2	1150	13.4	45—60-in.	6—48-in.	58.8	6.3	65.1	0.89	28.3
39	Kraft, bag	48.5	2880	50.6	935	22	51—60-in.	6—48-in.	66.7	6.3	73.0	1.08	30.2
40	Kraft, bag	39.5	2880	41.2	1140	14	51—60-in.	6—48-in.	66.7	6.3	73.0	1.07	28.0
41	Kraft, bag	39.5	2880	41.2	1135	15.7	51—60-in.	6—48-in.	66.7	6.3	73.0	1.07	28.1

[a] Plus 1—36-in. baby drier. [b] Ahead of size press.
S/W = drying surface per inch of width, square feet; R_p = production drying rate, pounds per hour per square foot; R_w = evaporative drying rate, pounds paper as dried.

3rd 20% of driers, 22.4% of evaporation
4th 20% of driers, 23.1% of evaporation
5th 20% of driers, 14.0% of evaporation

Board—Without "Overdrying"

In Fig. 7 are collected the drying curves on tests made on board machines which do not show the indication of serious loss of drying capacity due to overdrying. Tests nos. 13 and 17 have been described individually already.

The summarized data on these six tests show the following average rate of moisture removal through the drier section:

1st 20% of driers, 20% of evaporation
2nd 20% of driers, 25% of evaporation
3rd 20% of driers, 24% of evaporation
4th 20% of driers, 21% of evaporation
5th 20% of driers, 10% of evaporation

Board and Paper with "Overdrying"

Gathered in Fig. 8 are a family of drying curves on tests made on board and kraft paper machines where there is a definite loss in drying capacity due to "overdrying," or at least due to a considerable portion of the drier section operating with low drying rate due to low moisture content in the sheet.

Test no. 12 has already been described individually.

Tests nos. 14 and 15 were made on two machines running side by side and identical except for width. No steam gages were available.

Test no. 18 was on a machine having 111 driers arranged in three deck, making 0.016-in. jute board, at 345 f.p.m. Numerous drier surface temperatures were secured. Averaging 240°F. on the first eight driers, then 250°F. through drier no. 80, drier no. 89 and those following were 260 to 265°F. Drier no. 82 was found to be cold (200°F.) and this caused a drop in the sheet temperature as shown below. The steam pressure at the dry end driers was 36 p.s.i.

Sheet temperatures taken with the surface pyrometer in this test are informative. They are set down with the corresponding moisture content on the wet basis in Table II.

Table II

Drier No.	Per cent of driers	Sheet temperature, °F.	Moisture, %
0	0	50	65.9
3	3	90	65.2
4	4	112	65
9	8	135	64
15	14	140	61.5
21	19	140	59.4
33	30	150	55
39	36	155	52.2
45	41	165	47
51	47	160	40.7
57	52	165	34.5
63	58	180	28.5
69	63	180	22.5
75	69	185	16.5
81	74	185	10.5
83	76	175[a]	8
90	82	230	4
96	88	240	3
100	92	245	2.5
106	98	250	1.5
108	100	...	0.9

[a] After "cold" drier.

It is important to note in this table how rapidly the sheet temperature rises when the moisture content has been reduced to about 6%. A number of other such sheet temperature tests taken by Mr. Sawyer, as well as

Moisture leaving, %	M	Rw	To 5% final moisture: Rp′	Rw′	S/W ratio
3.8	3.12	1.19 = av. +	0.42	1.30 = G−	0.90
4.2	3.33	1.04 = av.	0.32	1.06 = av.	0.97
6.1	3.81	1.31 = G	..	..	..
1.6	1.55	1.18 = av. +	1.04	1.53 = G	0.73
2.6	1.49	0.87 = av. −	0.73	1.05 = av.	0.80
2.2	1.94	1.11 ...	0.74	1.37 ...	0.78
3.3	1.44	0.95 = av. −	0.77	1.07 = av.	0.85
3.5	1.55	1.48 = av. +	1.25	1.88 = G +	0.76
2.9	1.54	1.10 ...	0.96	1.43 ...	0.74
2.7	2.34	2.49 ...	1.11	2.51 ...	0.96
5.4	1.96	2.19 = av.	..	..	..
1.3	1.73	1.21 = P +	0.96	1.57 = av. −	0.73
6.0	1.94	1.50 = P +	..	..	..
2.0	1.59	1.10 ...	0.80	1.20 ...	0.87
2.7	1.70	1.31 ...	0.88	1.42 ...	0.88
1.4	..	..	..	..	..
14.5	1.46	1.34 ...	..	..	..
0.9	1.90	1.58 = P	1.31	2.35 = av. − G	0.81
7.5	1.97	2.14 = av. +	..	..	..
3.0	1.79	2.70[b] ...	1.61	2.79 ...	0.94
2.0	1.91	1.84 ...	1.32	2.40 ...	0.73
6.8	2.18	2.40 = G	..	..	..
3.4	2.50	1.59 ...	0.71	1.73 ...	0.90
5.0	1.73	1.27 ...	..	..	..
4.9	1.97	1.26 ...	0.82	1.62 ...	0.77
3.1	2.13	1.19 ...	0.83	1.72 ...	0.67
1.7	2.24	2.37 = av.	1.38	2.95 = G	0.77
1.7	2.82	2.77 = av. − G	1.19	3.20 = G	0.82
6.4	1.90	1.91 = P −	..	..	..
2.3	2.07	1.36 = P −	..	..	..
4.1	2.19	2.36 = av. − G	1.10	2.37 = av. − G	0.98
4.1	1.86	1.77 = P − av.	0.97	1.78 = P − av.	0.98
1.1	2.12	1.66 = P − av.	0.84	1.67 = P − av.	0.93
3.3	2.23	3.22 = G −	1.54	3.36 = G	0.93
1.8	2.51	2.13 = P	1.00	2.39 = P − av.	0.85
1.9	2.21	3.62 = G +	1.82	3.83 = G +	0.90
2.5	2.44	2.18 = G −	1.03	2.42 = G	0.87
2.7	2.22	2.40 = av. +	1.56	3.35 = G +	0.69
4.4	2.41	2.58 = G −	1.32	3.16 = G + −	0.81
3.5	2.44	2.60 = G	1.22	2.91 = G +	0.87

er hour per square foot; M = pounds moisture evaporated per pound

number taken by the writer, show this abrupt rise n the sheet temperature occurring at 8 to 11% mois- ure, apparently depending on the type of board. It s suggested that the position in the drier nest of this brupt rise in sheet temperature affords a convenient nd reliable measure of loss of drying capacity due to verdrying.

Tests nos. 28, 29, and 39 are included here, but it is o be noted that whereas the others are on board nachines, these are on fourdrinier machines with drier elts and felt driers.

Summarizing the drying rate variation for this group f seven tests the average is as follows:

1st 20% of paper driers, 26% of evaporation
2nd 20% of paper driers, 26% of evaporation
3rd 20% of paper driers, 28% of evaporation
4th 20% of paper driers, 17% of evaporation
5th 20% of paper driers, 3% of evaporation

In this group of tests, only 69 to 88% of the total rying surface was required to reduce the moisture con- ent to 5%. For the average of these seven machines he sheet had been dried to 5% moisture content by he time it approached the last 20% of the drier ection.

EXPLANATION OF S/W RATIO IN TABLE I

The last three columns in Table I show the drying ates recalculated using as drying surface, S/W, that otal surface, including felt driers, preceding the point here the moisture content of the sheet has been re- uced to 5% on the usual wet basis. This point is eadily obtained from the drying curves. The pro- uction drying rate to 5% final moisture, R_p', is btained by changing the over-all R_p by the ratio of the ver-all S/W to the reduced S/W.

The moisture evaporation from the initial moisture to 5% final moisture gives a new figure for M, the pounds of water evaporated per pound of paper as dried, and the product of this new M and R_p' gives R_w'.

The S/W ratio shown in the last column is the ratio of the total drying surface up to the point of 5% final moisture content to the actual total drying surface. In other words a ratio of 0.85 means that 85% of the total drying surface (including felt driers, if any) was used in reducing the moisture content to 5% and the remaining 15% of the driers were used in drying the sheet still further.

Of course it is not in the least to be inferred that 5% final moisture is proper and any other is wrong. This figure was selected arbitrarily to permit making comparisons, and for showing the effect on the drying capacity of any machine of drying to low moistures.

CONCLUSIONS

The tests presented in this report appear adequate in scope and accuracy to permit reaching definite conclusions on the variation of drying rate through the drier section of any paper or board machine.

By means of the results presented here in graphical form it is possible to predict the moisture content of the paper with sufficient accuracy at any point of the drier section, and thus to locate intelligently such components as a breaker stack, size press, or coater. The amount of evaporation from any portion of the drier section, or the condensate from any group of driers, may now be estimated with reasonable accuracy.

It is at once evident that the drying rate, for a uniform steam pressure, is remarkably constant to the point where the moisture content is down to about 10 or 15%, after which it decreases rapidly and greatly.

These tests disclose that on many machines a much greater proportion of the driers than is commonly supposed is used for removal of the last final percentages of moisture. As shown in some of these tests, even a slight increase in the final moisture content would provide a substantial increase in drying capacity. It must not be concluded, however, that final moisture content is, next to steam pressure, the greatest factor in determining over-all drying rate. The evaporative drying rate, R_a, between the limits of 20 and 60% of the paper driers—thereby eliminating wet-end and dry-end variations—has been plotted against steam pressure or temperature, and although the tabulations and plotted results are omitted here to save space, it was found that extremely wide variations still existed at any given steam pressure. The fact remains, therefore that those factors which affect the effectiveness of heat transfer contact between the drier sheet and the paper are normally the dominant factors in determining drying rate at a given steam pressure.

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Some Factors in the Color Reversion of Bleached Secondary Fiber

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Secondary fiber obtained by deinking of wastepaper tends to revert in color after bleaching. A number of factors involved in deinking and bleaching waste magazine stock were studied in the laboratory to determine their effect on color reversion. Experiments with three different deinking agents showed that in general there was the least color reversion with peroxide, and the most with sodium hydroxide, with sodium carbonate being intermediate. Up to deinking temperatures of 160°F. an increase in temperature resulted in less color reversion; a further raise in temperature above 160°F. brought about slightly greater reversion. In the bleaching operation, experiments were made in varying total chlorine, chlorine in chlorination stage, and the hypochlorite. Increase of total chlorine and of the final brightness of the bleached stock gave less color reversion. Buffered bleaching or high alkalinity in the hypochlorite stage gave higher brightnesses and less color reversion. It was found, under the experimental conditions observed, that hypochlorite bleaching at 110°F. produced the highest brightness with greatest color reversion; that 140°F. gave the lowest brightness with least color reversion, and that 80°F. showed intermediate results. The use of a 1% caustic extraction stage decreased the loss of color. No further benefit was found in the use of over 1% caustic. Where peroxide was employed as an additional stage for final brightening, less color reversion was experienced.

In the preparation of pulps for commercial use a natural objective is the production of pulps having good brightness with a minimum loss of this property upon aging in storage. In the case of virgin fibers this aim is pursued by selection of cooking processes and by further purification with multistage bleaching methods.

In a similar manner the production of secondary fibers from deinked wastepaper calls for a cooking process (an alkaline deinking) and a further purification by bleaching treatment. In one respect, however, secondary fiber production differs from virgin fiber production in that secondary fibers may contain a wide variety of pulps derived originally from sulphites krafts, sodas, and groundwoods. The presence of such nonhomogeneous materials in secondary fibers may give rise to severe color reversion.

When secondary fiber (deinked wastepaper) is bleached, it is frequently observed that a considerable drop in brightness occurs after natural storage. Also this loss of brightness may be severe in some instances and relatively minor in other cases. A laboratory investigation has, therefore, been undertaken to determine some of the factors which may cause color reversion in secondary fibers.

DESCRIPTION OF METHODS

Secondary fiber produced from wastepaper normally may vary considerably in its final characteristics due t the nonuniformity of wastepaper itself. Hence, i these experiments a "standard" batch of wastepape was used throughout. This standard batch was pre pared from a 50-50 mixture of a free magazine and high groundwood content magazine. Fifty pounds o these magazines were collected, shredded into sma pieces, thoroughly mixed, and allowed to condition Equal quantities of the shredded magazines wer weighed and carefully blended for the deinking pro cedure so that a furnish with about 25% groundwoo resulted in every case for deinking.

The plan for the investigation was to hold all know variables constant with the exception of the particula variable under consideration. Therefore, a somewha arbitrary procedure was devised and maintained durin the experiments.

Where larger quantities of stock than those specifie in the previous operation were required, the procedur was repeated until the necessary quantities were ob tained, and the resultant stocks were mixed togethe for use in the next phase.

Defibering and deinking were carried out in 25-gra batches (paper as received) at 5% moisture-free consist ency. The agitation was done in 1-qt. fruit jars b means of Hamilton Beach high-speed mixers for 1 min. With the exception of the special series of test run at 110, 130, and 200°F. all deinking was conducte at 160°F. One series of deinking tests was carrie out with three different deinking agents; i.e., sodium hydroxide (4% on weight of fiber), sodium carbonat (10% on weight of fiber), and a sodium peroxide– sodium hydroxide–sodium silicate mixture (2, 2, an ½% respectively, on weight of fiber). All other deink ing was done with the sodium hydroxide. Each batch of deinked stock was carefully washed on laboratory wire screens until the effluent became clear. The wir was a fine mesh having 70 by 52 meshes per sq. in.

The acid chlorine number of each of the deinked an washed stocks was determined by our mill method This calls for weighing out an amount of stock equiva lent to 2.5 grams moisture-free pulp. The weighe sample is transferred to a 500-ml. wide mouth Erlen meyer flask and made up to a volume of 465 ml. It i heated to 85°F. and 5 ml. of 1 *N* hydrochloric acid ar added. The flask is then placed under an agitato and sealed. Standard bleach liquor (containing ap proximately 5.83 grams chlorine per liter but accurately standardized) is run in a quantity equivalent to exactly 0.175 gram available chlorine (i.e., approximately 3 ml.) and the flask again sealed. At the end of 10 min 10 ml. of 10% KI solution are added and the content of the flask are back titrated with 0.1 *N* sodium thio sulphate solution, running the solution in until the orange color of the suspension has practically faded

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Table I. Influence of Deinking Agents

	Deinking temperature, 200°F. reagent used			Deinking temperature, 160°F. reagent used			Deinking temperature, 130°F. reagent used			Deinking temperature, 110°F. reagent used		
	4% $NaOH$	10% Na_2CO_3	2% Na_2O_2	4% $NaOH$	10% Na_2CO_3	2% Na_2O_2	4% $NaOH$	10% Na_2CO_3	2% Na_2O_2	4% $NaOH$	10% Na_2CO_3	2% Na_2O_2
After bleaching	72.5	75.9	72.0	75.7	72.0	77.3	75.3	72.5	76.4	74.8	72.5	75.4
After 24 hr.	71.4	74.0	..	74.1	70.2	76.2	72.9	71.7	75.0	72.4	71.5	73.9
After 48 hr.	70.0	..	69.9	73.5	69.7	75.7	71.8	71.1	74.8	71.4	70.4	73.0
After 72 hr.	..	73.0	70.0	72.1	69.5	76.0	71.2	70.6	74.6	71.0	69.8	72.5
After 96 hr.	69.0	72.8	70.0	72.2	69.5	75.8	70.9	70.1	74.4	70.0	69.5	72.7
After 120 hr.	68.9	72.7	70.1	71.7	69.0	75.6	70.7	69.7	74.3	69.6	68.5	72.3
Brightness drop, 120 hr.	3.6	3.2	1.9	4.0	3.0	1.7	4.6	2.8	2.1	5.2	4.0	3.1
Cl_2 for chlorine, %	4.96	6.45	5.20	5.94	6.55	6.35	6.04	6.51	6.26	5.78	6.66	5.86
Cl_2 as hypo, %	3.29	4.23	3.47	3.96	4.36	4.23	4.02	4.34	4.17	3.85	4.44	3.90
Time of deinking, hr.	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Time of chlorination, hr.	5	5	5	5	5	5	5	5	5	5	5	5
Time of hypo, hr.	5	5	5	5	5	5	5	5	5	5	5	5

(*Note:* the suspension will not turn colorless due to the brown color of the chlorinated pulp.) Five milliliters of starch indicator are next added and the titration continued with the 0.1 *N* sodium thiosulphate solution until a creamy white end point, that is, one that remains 5 sec. before the blue starch iodine color returns.

$$\text{Acid chlorine number} = \frac{[0.1750 - (\text{ml. } 0.1\ N\ Na_2S_2O_3 \times 0.00355)]}{2.5} \times 100$$

For chlorination (as the first stage of the bleaching procedure) 60-gram samples, moisture-free basis, of the deinked stock were chlorinated at room temperature with 150% chlorine based on the acid chlorine number. (In one series of experiments, this amount of chlorine was varied to determine its effect upon color reversion.) Chlorine was added in the form of filtered bleach liquor into which sufficient hydrochloric acid was introduced to obtain a pH of 2.0 and the chlorination was carried out at 4% moisture-free consistency. The chlorination was allowed to proceed, with frequent stirring by hand, until the chlorine was exhausted as shown by starch-iodide indicator, or until 5 hr. had elapsed if not completely exhausted. Samples were then washed until the stock gave negative results to the starch-iodide indicator.

Hypochlorite bleaching was performed at 6% moisture-free consistency on 50-gram samples of washed, chlorinated stock. Except in a series where 80 and 40°F. temperatures were also employed, temperature was maintained throughout the hypochlorite stage at 10°F. by means of a constant temperature water bath. The amount of bleach liquor as calcium hypochlorite was based on adding an equivalent amount of chlorine equal to 100% of the acid chlorine number (unless otherwise specified as in the case of one series where the amount of hypochlorite was varied to study its effect on color reversion). The hypochlorite bleaching was run until exhaustion as shown with starch-iodide indicator or until 5 hr. had elapsed if not completely exhausted. Except in the series where pH variations during the hypochlorite stage were investigated, all hypochlorite bleaching was done without buffering, i.e., the pH was allowed to drop off as the bleaching proceeded.

The peroxide bleaching was carried out with 2% sodium peroxide which had been buffered and stabilized with sodium silicate, sulphuric acid, and magnesium sulphate (Epsom salt). Freshly prepared batches of peroxide were made with 166.6 ml. of distilled water, 10 grams of sodium silicate (41.5° Bé.) containing 29% SiO_2 and 8.9% Na_2O, 40 grams of sodium silicate, 1.9 ml. of concentrated sulphuric acid (clear, colorless grade of 66° Bé.), and 0.05 gram Epsom salt ($MgSO_4 \cdot 7H_2O$). Time of bleaching was 5 hr. and pulp consistency was 5% moisture-free.

Samples of all stocks, after final bleaching was completed, were made into handsheets, air-dried overnight (approximately 16 hr.) in an air-conditioned room at 72°F. and 50% relative humidity. The brightness value was then determined on a General Electric reflectometer using the no. 1 filter in the standard manner.

The remainder of all stocks after bleaching were kept in sealed bottles as slush pulp at 72°F. Additional samples were then made into handsheets at 24, 48, 72, 96, and 120-hr. intervals, air-dried, and tested as above.

All data presented in the tables are based on the average of samples run in triplicate or more.

DEINKING FACTORS

Two deinking factors were investigated in this work: first, the type of chemical used for deinking and second,

Table II. Influence of Deinking Temperatures

	Deinking agent, 4% $NaOH$, temperature				Deinking agent, 10% Na_2CO_3, temperature				Deinking agent, 2% Na_2O_2, temperature			
	200°F.	160°F.	130°F.	110°F.	200°F.	160°F.	130°F.	110°F.	200°F.	160°F.	130°F.	110°F.
Brightness												
After bleaching	72.5	75.7	75.3	74.8	75.9	72.0	72.5	72.5	72.0	77.3	76.4	75.4
After 24 hr.	71.4	74.1	72.9	72.4	74.0	70.2	71.7	71.5	..	76.2	75.0	73.9
After 48 hr.	70.0	73.5	71.8	71.4	..	69.7	71.1	70.4	69.9	75.7	74.8	73.0
After 72 hr.	..	72.1	71.2	71.0	73.0	69.5	70.6	69.8	70.0	76.0	74.6	72.5
After 96 hr.	69.0	72.2	70.9	70.0	72.8	69.5	70.1	69.5	70.0	75.8	74.4	72.7
After 120 hr.	68.9	71.7	70.7	69.6	72.7	69.0	69.7	68.5	70.1	75.6	74.3	72.3
Brightness drop, 120 hr.	3.6	4.0	4.6	5.2	3.2	3.0	2.8	4.0	1.9	1.7	2.1	3.1
Cl_2 for chlorination, %	4.96	5.94	6.04	5.78	6.45	6.55	6.51	6.66	5.20	6.45	6.26	5.86
Cl_2 for hypo, %	5.29	3.96	4.02	3.85	4.23	4.36	4.34	4.44	3.47	4.23	4.17	3.90
Time of deinking, hr.	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Time of chlorination, hr.	5	5	5	5	5	5	5	5	5	5	5	5
Time of hypo, hr.	5	5	5	5	5	5	5	5	5	5	5	5

Table III. Influence of Chlorine Variations in Chlorination and Hypochlorite Stages

	Constant amount chlorine in chlorination stage, varying hypochlorite, %			*Constant amount hypochlorite in hypo stage, varying chlorination, %*		
	70–30	*60–40*	*50–50*	*70–30*	*60–40*	*50–50*
Brightness						
After bleaching	74.0	76.7	76.9	77.7	76.7	73.8
After 24 hr.	71.8	75.5	76.3	76.3	75.5	72.1
After 48 hr.	71.9	74.3	76.3	..	74.3	71.1
After 72 hr.	70.4	74.7	76.5	76.3	74.7	71.7
After 96 hr.	70.5	73.7	75.7	75.6	73.7	70.4
After 120 hr.	70.4	73.2	75.7	75.9	73.2	70.0
Brightness drop, 120 hr.	3.6	3.5	1.2	1.8	3.5	3.8
Cl_2 for chlorination, %	6.03	6.03	6.03	9.29	6.03	4.02
Cl_2 for hypochlorite, %	2.57	4.02	6.03	4.02	4.02	4.02
Time of deinking, hr.	1/4	1/4	1/4	1/4	1/4	1/4
Time of chlorination, hr.	5	5	5	5	5	5
Time of hypo, hr.	5	5	5	5	5	5

Table IV. Influence of Chlorine Distribution Between Chlorination and Hypochlorite Stages

	Total chlorine constant		
	Chlorination 70%–hypochlorite 30%	*Chlorination 60%–hypochlorite 40%*	*Chlorination 50%–hypochlorite 50%*
Brightness			
After bleaching	75.9	76.1	75.4
After 24 hr.	74.4	75.2	74.9
After 48 hr.	73.0	73.5	74.0
After 72 hr.	72.6	73.4	72.1
After 96 hr.	72.9	73.2	73.4
After 120 hr.	71.9	73.6	73.1
Brightness drop, 120 hr.	4.0	2.5	2.3
Cl_2 for chlorination, %	6.86	5.88	4.90
Cl_2 for hypo, %	2.94	3.92	4.90
Time of deinking, hr.	1/4	1/4	1/4
Time of chlorination, hr.	5	5	5
Time of hypo, hr.	5	5	5

the temperature of deinking. As it was considered possible that one deinking agent might give different results than another at various temperatures, a series of experiments was run at 110, 130, 160, and 200°F. for three deinking agents—sodium hydroxide, sodium carbonate, and a sodium peroxide–sodium hydroxide–sodium silicate mixture.

The data obtained in these experiments are listed in Table I which is arranged to show the influence of the type of deinking agent and in Table II which is designed to show the influence of the deinking agent.

The data show that sodium peroxide deinking in all cases at equivalent temperatures gives less color reversion as is seen from the drop in brightness after 120 hr. than does sodium carbonate which is intermediate, and than does sodium hydroxide which gives the greatest reversion after 120 hr. In most cases, sodium peroxide deinked stock also gave the highest brightness, with sodium carbonate the lowest brightness.

Up to temperatures of 160°F. the increasing of the temperature of deinking reduced the color reversion of the finished bleached stock. Above 160°F. raising the temperature of deinking appeared to increase the brightness drop very slightly.

BLEACHING FACTORS

Variations in Chlorine and Hypochlorite Stages

The relationship between the distribution of chlorine and of hypochlorite in bleaching and their effect on color reversion was studied in four ways: first, holding the amount of chlorine added in the chlorination stage constant and varying the hypochlorite addition; second, keeping the amount of hypochlorite constant and varying the chlorine addition in the chlorination step; third, holding the total chlorine constant and varying the distribution between the two stages; and fourth, compilation of the data obtained in the preceding three phases so as to show the effect of variations in the total chlorine.

Table III shows the influence of chlorine variations in the chlorination and hypochlorite stages. An increase in the amount of chlorine in the first stage or of hypochlorite in the second stage results in higher brightness and also in less color reversion. An increase in hypochlorite appears to be slightly more effective in reducing color reversion than does an increase in chlorine in the chlorination stage.

In Table IV, the total chlorine was held constant and the distribution of chlorine as chlorine and as hypochlorite was varied. This table again shows that the chlorine used in the hypochlorite stage is slightly more effective in reducing color reversion than chlorine used in chlorination.

Table V is a tabulation of the preceding data, and in general, indicates that increasing the total chlorine lowers the color reversion.

Influence of pH Variations During the Hypochlorite Stage

The influence of the pH during the course of the hypochlorite bleaching was investigated. Samples were bleached with hypochlorite in five different ways

Table V. Influence of Total Chlorine

	Per cent of total chlorine used							
	8.04	*8.60*	*9.80*	*9.80*	*9.80*	*10.05*	*12.06*	*13.31*
Brightness								
After bleaching	73.8	74.0	75.9	76.1	75.4	76.7	76.9	77.7
After 24 hr.	72.1	71.8	74.4	75.2	74.9	75.5	76.3	76.3
After 48 hr.	71.1	71.9	73.0	73.5	74.0	74.3	76.3	..
After 72 hr.	71.7	70.4	72.6	73.4	72.1	74.7	76.5	76.3
After 96 hr.	70.4	70.5	72.9	73.2	73.4	73.7	75.7	75.6
After 120 hr.	70.0	70.4	71.9	73.6	73.1	73.2	75.7	75.9
Brightness drop, 120 hr.	3.8	3.6	4.0	2.5	2.3	3.5	1.2	1.8
Cl_2 for chlorination, %	4.02	6.03	6.86	5.88	4.90	6.03	6.03	9.29
Cl_2 for hypo, %	4.02	2.57	2.94	3.92	4.90	4.02	6.03	4.02
Time of deinking, hr.	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Time of chlorination, hr.	5	5	5	5	5	5	5	5
Time of hypo, hr.	5	5	5	5	5	5	5	5

Table VI. Influence of pH During Hypochlorite Bleaching

	Unbuffered initial pH 8.5	*Adjusted with lime to initial pH 12.0*	*Adjusted and maintained with dolomitic lime to pH 8.5 to 9.0*	*Adjusted and maintained with lime to pH 8.5 to 9.0*	*Adjusted and maintained with sodium hydroxide to pH 8.5 to 9.0*
Brightness					
After bleaching	76.4	76.4	77.4	77.7	76.8
After 24 hr.	..	75.4	77.5	77.3	76.8
After 48 hr.	75.5	75.4	77.7	77.3	76.7
After 72 hr.	74.7	76.1	77.5	76.9	76.4
After 96 hr.	74.2	76.3	77.9	77.4	77.1
After 120 hr.	73.9	77.6	78.2	77.3	77.7
Brightness drop, 120 hr.	2.5	None	None	0.4	None
Cl_2 for chlorination, %	6.66	7.14	7.14	7.14	7.14
Cl_2 for hypo, %	4.44	4.76	4.76	4.76	4.76
Time of deinking, hr.	1/4	1/4	1/4	1/4	1/4
Time of chlorination, hr.	5	5	5	5	5
Time of hypo, hr.	5	5	5	5	5
Initial pH	8.5	12.0	9.0	9.0	9.0
Final pH	5.02	6.34	8.12	8.17	8.32

irst, with no pH adjustment, i.e., allowing the initial pH of 8.5 to drop; second, with the pH adjusted to 12.0 with lime and then allowing it to drop; third, the pH adjusted to 9.0 with dolomitic lime, then additional (dolomitic) lime added during the bleaching cycle to maintain a pH between 8.5 and 9.0; fourth, the pH adjusted to 9.0 with sodium hydroxide, then the pH during bleaching maintained by additional caustic; and fifth, and pH adjusted to 9.0 with ordinary milk of lime and kept at this value during bleaching by additional ime. On the buffered samples, pH measurements were aken every 15 min. and additional material added as equired.

Table VI shows the data obtained. In general, there was little or no color reversion where buffered bleaching or high alkalinity was employed as compared to a 2.5 point drop where no alkaline addition was made.

nfluence of Temperature Variations on Hypochlorite tage

The effect of temperature was studied at three different temperatures, 80, 110, and 140°F. It was found hat at 110°F. the highest brightness was obtained, but hat also the greatest color reversion was experienced. Conversely at 140°F. the lowest brightness was produced but there was the least color reversion. The esults at 80°F. were intermediate between those at 40 and 110°F. Complete data are shown in Table VII.

nfluence of Peroxide Treatment

The use of a peroxide stage, both as a hypochlorite tage replacement and also a hypochlorite stage supplement was tried. In the case of a peroxide stage supplementing the usual hypochlorite stage, a higher brightness was obtained and there was less color reversion than in the case where no peroxide treatment was given.

Where the use of a peroxide treatment was tried to replace the normal hypochlorite stage, insufficient whitening and brightening action was obtained with 2% peroxide. Further work will be attempted with higher percentages of peroxide. It is interesting to note, however, that the low brightness obtained did not revert further.

Table VII. Influence of Bleaching Temperature in Hypochlorite Stage

	Temperature of hypochlorite state		
	80°F.	*110°F.*	*140°F.*
rightness			
After bleaching	74.9	76.4	74.4
After 24 hr.	..	..	..
After 48 hr.	73.7	75.5	73.8
After 72 hr.	73.6	74.7	73.8
After 96 hr.	73.6	74.2	73.8
After 120 hr.	73.5	73.9	73.9
rightness drop, 120 hr.	1.4	2.5	0.5
l_2 for chlorine, %	6.66	6.66	6.66
l_2 for hypochlorite, %	4.44	4.44	4.44
ime of deinking, hr.	1/4	1/4	1/4
ime of chlorination, hr.	5	5	5
ime of hypochlorite, hr.	5	5	5

Influence of Caustic Extraction

The effect of a caustic (sodium hydroxide) extraction between the chlorination and hypochlorite stages was investigated. For this treatment a temperature of 150°F., a time of 1 hr., and a pulp consistency of 11% was used. Three concentrations of caustic were used, namely, 1, 2, and 3% (based on the weight of the pulp). It was found that the caustic extracted pulp was 3 to 4 points brighter than a nonextracted pulp and that the caustic extracted pulp showed about 2 points less drop in brightness. There was only a very slight improvement in brightness and color reversion using 3% caustic as against 1%.

Table VIII. Influence of Peroxide Bleaching

	No peroxide treatment	*Peroxide replacing hypochlorite stage*	*Peroxide supplementing hypochlorite*
Brightness			
After bleaching	78.8	61.6	80.1
After 25 hr.	78.1	61.6	79.0
After 48 hr.	76.6	62.1	80.5
After 72 hr.	76.7	61.6	79.8
After 96 hr.	..	62.3	79.4
After 120 hr.	76.1	..	79.3
Brightness drop, 120 hr.	2.7	None	0.8
Cl_2 for chlorination, %	6.35	6.35	6.35
Cl_2 for hypochlorite, %	4.23	..	4.23
Na_2O_2, %	..	2.0	2.0
Time of deinking, hr.	1/4	1/4	1/4
Time for chlorination, hr.	5	5	5
Time for hypochlorite, hr.	5	..	5
Time for peroxide, hr.	..	5	5

SUMMARY

A number of factors involved in the preparation of bleached secondary fiber (deinked wastepaper) were investigated for their effect on color reversion. It appears that color reversion is affected by many factors common to deinking and bleaching practices. In deinking, both the type of deinking agent and the temperature of deinking are important. In these experiments, it was found that peroxide deinking and temperatures of 160°F. gave less color reversion.

In bleaching, increasing the total chlorine used lessened the drop in color. Addition of chlorine as hypochlorite seemed to have somewhat greater effect in decreasing color reversion. It was found that buffered bleaching or high alkalinity in the hypochlorite stage produced pulps with little or no loss in brightness after a 5-day storage. Temperature of the hypochlorite stage was found to influence color reversion with least color reversion taking place at 140°F. although the brightness of stock produced at this temperature was not as good as at lower temperatures. A 1% caustic extraction between chlorination and hypochlorite stages resulted in improved brightness of the bleached pulp and less drop in brightness. The use of a peroxide stage as a supplement to chlorination and hypochlorite stage gave higher brightness and a pulp which had improved in color reversion tendencies.

Additional work is in progress and will be reported at a later date.

Table IX. Influence of Caustic Extraction

	No caustic extraction stage	*1% NaOH extraction*	*2% NaOH extraction*	*3% NaOH extraction*
Brightness				
After bleaching	76.6	79.8	80.1	80.1
After 24 hr.	75.3	80.0	80.2	80.5
After 48 hr.	74.8	79.9	79.6	79.8
After 72 hr.	73.5	78.6	79.7	79.5
After 96 hr.	73.9	79.3	..	79.1
After 120 hr.	73.7	78.9	79.1	79.4
Brightness drop, 120 hr.	2.9	0.9	1.0	0.7
Cl_2 for chlorination, %	5.90	5.90	5.90	5.90
Cl_2 for hypo, %	3.93	3.93	3.93	3.93
Time of deinking, hr.	1/4	1/4	1/4	1/4
Time for chlorination, hr.	5	5	5	5
Time for hypo, hr.	5	5	5	5
Time for caustic extraction, hr.	1	1	1	1

The authors wish to acknowledge the valuable assistance of the laboratory staff of the Niagara mill of the International Paper Co.

Beater Additives in Papermaking

P. B. DAVIDSON

Several so-called beater additives have been evaluated for their influence on engine sizing of paper. The viscosity and degree of substitution of the cellulose and starch derivatives studied govern, to some extent, the "size additive" efficiency. The degree of sizing in a paper should be judged from the standpoint of its use requirements. This is particularly true when size additives are used because they appear to be somewhat specific toward certain types of writing inks or aqueous solutions such as diazo or photosensitive coating solutions. Size additives also exhibit specificity toward different papermaking fibers. The rosin sizing of sulphite and sulphate papers can be significantly improved by the inclusion of some types of size additives but these additives appear to have little value as "sizing improvers" in rag papers. In rag-sulphite pulp mixtures the size additive efficiency decreases with increased rag fiber content of the paper. No conclusions are drawn from this work except that too little is known about the surface chemistry of various papermaking fibers.

At a TAPPI meeting in New York several years ago the perennial subject of beating of cellulose fibers was under discussion. One of those in attendance voiced the hope that some day we would add "hydration" from a bucket. This apparently facetious remark must have been taken seriously by the chemical industry for within the last few years some mannogalactans as well as several derivatives of cellulose and starch have been placed on the market that fulfill, in a general way, th wish for synthetic hydration.

Such an application of water-dispersible derivatives cellulose and starch is not new. Oriental papermake have added natural water-soluble gums to their pape for many years to improve the strength and other phys cal properties. It is only recently that science ha been catching up with the art and has made a study the application of water-soluble natural and synthet "gums" to papermaking. Papers made in the Weste World require different properties than those found the old oriental papers. Our methods of writing an printing are largely responsible for this. The history papermaking and the graphic arts shows why engine beater sizing was inevitable. The recent interest natural and synthetic gums as beater additives has bee not only for the improvement of strength properties an formation of the paper but also as an aid to rosin engine sizing.

As is the case with most new developments in pap technology, they usually are designed for woodpul papers. This is rightly so, for by far the largest mark is in this field. However, this does not prevent th rag content paper manufacturer from trying them ou The problems of beating and engine sizing are far mo critical for him than for the pulp-paper manufactur It has long been common knowledge that rag stock much more difficult to both beat and size than pulp This is to be suspected when it is realized that the chem ical history of these two types of fibers is so differen

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Thus any improvement in sizing efficiency that would either assume better sizing or reduce the variations in size additions to obtain a satisfactory sheet would be welcome.

The first experiments that were conducted in the author's laboratory consisted of adding sodium carboxymethyl cellulose (CMC) to a Bewoid-sized sulphite pulp furnish. It was soon found that the high viscosity types were superior as size additives. There appeared to be a direct relationship between viscosity of the CMC and the sizing imparted to the paper. Although CMC possessed no sizing properties in itself it did appear to act as a "protective colloid" to prevent agglomeration of the size particles when alum was added. When CMC samples from different producers were evaluated the term "high viscosity" was meaningless. What was considered high by one producer was intermediate to another. The viscosity ranges for the three types of CMC are listed in "Water-Soluble Gums" by Mantell (page 152) as follows;

Low viscosity.....25 to 50 cp. in 2% solution
Medium viscosity.....400 to 600 cp. in 2% solution
High viscosity.....approximately 1500 cp. in 1% solution

However there were found to be such large differences in the behavior of the same "viscosity type" of CMC that it was considered necessary to obtain actual determinations of their viscosity. The method used for these determinations was, of necessity, that with the Brookfield viscometer. There was so much fibrous material in some of the samples that a capillary tube method could not be used with any degree of accuracy and the falling ball method required such modification that it was deemed advisable, for these purely comparative determinations, to use the Brookfield. The determinations were made with 1% dispersions of the high viscosity types of four brands of CMC. In Table I are given the viscosity values, along with the sizing obtained with the particular CMC as a size additive. The sizing was Bewoid size. As can be seen from these results, viscosity was not necessarily the only criterion of size additive efficiency. Another factor apparently was involved, that of degree of substitution of carboxymethyl groups in the cellulose. For the subsequent work, that is described here, one particular brand of high viscosity type of CMC was selected so as to reduce this particular variable as much as possible.

The term "protective colloid" is an easy way of explaining why CMC improved engine sizing but what does it really mean? To gain a clear picture of what does happen when CMC is added to a system containing rosin size, some blank furnishes were examined under the microscope. These blank furnishes contained the standard quantities of Bewoid size and alum used in the laboratory procedure for making handsheets but were free from any papermaking fibers. The particle size of the emulsified rosin was measured as 2 mu or smaller. Under the microscope these particles in the blank furnish appear to be individually embedded in a mass of transparent material and maintaining their original size. The CMC appeared to prevent the coalescence of the rosin particles into larger aggregates. If such coalescence occurred in some furnishes the CMC would not redisperse the size. If we concede that sizing efficiency depends upon the deposition of the 2 mu size particles on the fibers or conversely, that if they are deposited in larger coalesced state, the sizing efficiency is thus reduced by the resultant lack of "covering power." Apparently the CMC is effective only in the former instance. In other words, CMC or any size additive, can improve good sizing but not restore poor or improperly precipitated size.

Table I

CMC brand	*Color of dispersion*	*Viscosity, cp.*	*Ink penetration time, sec.*
1	None	80	450
2	Light pink	80	267
3	Light yellow	120	325
4	Light yellow	320	113

This brings up the question of the best point at which to add the size additive. From the logic of the question, it would be concluded that the CMC should be added before the size and alum. In some cases this appeared to be true while in others equally satisfactory results were obtained by adding it after the size, as in the stuff chest or just before the wire of the machine. In either case the level of sizing appeared to be raised by the additive but the rather wide fluctuations in sizing persisted.

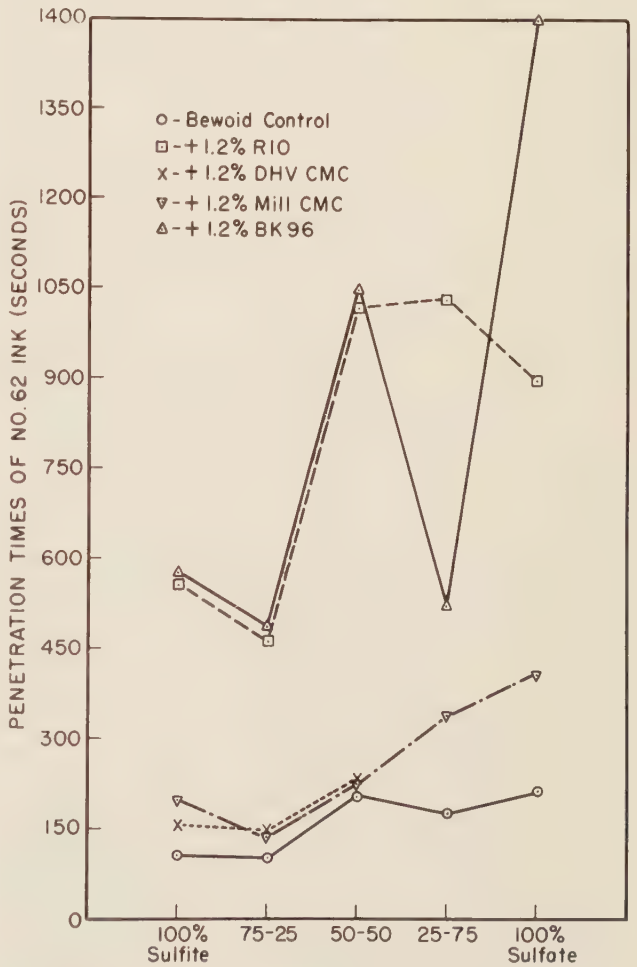

Fig. 1. Bewoid sized sulphite-sulphate mixture

It might be well to stop and consider what we mean by sizing. The definition given in the "Dictionary of

Paper" is so inadequate that it implies that every user and maker of paper understands the term. Perhaps they do, if sizing is determined by its use requirements. Without going to extreme cases for illustration, this understanding of sizing can be limited to the narrow field of technical papers. By "technical papers" is

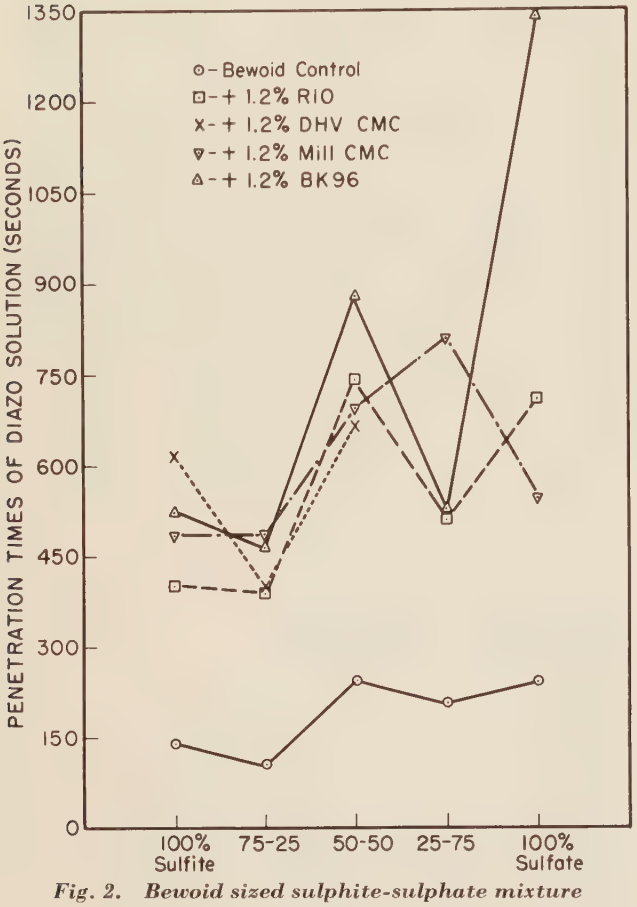

Fig. 2. Bewoid sized sulphite-sulphate mixture

meant blueprint, negative, and direct print or diazo reproduction papers. Far more stringent requirements are demanded for these papers than for bond, writing, book, or others in the "fine paper" group. It is obvious, therefore, that a paper that is well sized for a bond would not necessarily prove satisfactory as a blueprint paper. Part of the difficulty in determining the suitability of a paper for its use requirement rests in the methods used in testing the paper's sizing. It appears inconsistent, to say the least, to determine the water-absorbent properties of a paper when its use requirement is high resistance to penetration of rather concentrated solutions of complex salts. An ink penetration test is the logical one for bonds and writing papers but there is little reason to expect that it would indicate the degree of sizing required for either blueprint or a diazo print paper. This was well illustrated by an attempt to formulate a penetration test ink that would substitute for a diazo coating solution. For various reasons it was desirable to obtain a substitute solution that would give the same differentiation of sizing as this solution. A blue ink was prepared having the same pH and surface tension as the diazo solution but it did not function in the same manner as a penetration test solution.

A study was made of some of the variables that affec a penetration test for sizing. One of the most obviou of these is the temperature at which the test is made Table II shows the variations in penetration time of th diazo coating solution with changing temperature of th solution.

Table II. Effect of Temperature on Penetration Tim

Test solution	*Temperature, °C.*	*Penetration time, sec.*
Diazo solution	3.5	5.2
Diazo solution	10.0	3.4
Diazo solution	15.0	1.9
Diazo solution	20.0	1.6
Diazo solution	25.0	1.1

The differential of penetration time per 1 °C. chang in temperature appeared to be small at 20 °C. and as thi was also a convenient temperature condition to mair tain for the test, it was adopted as the standard cond tion for this sizing test.

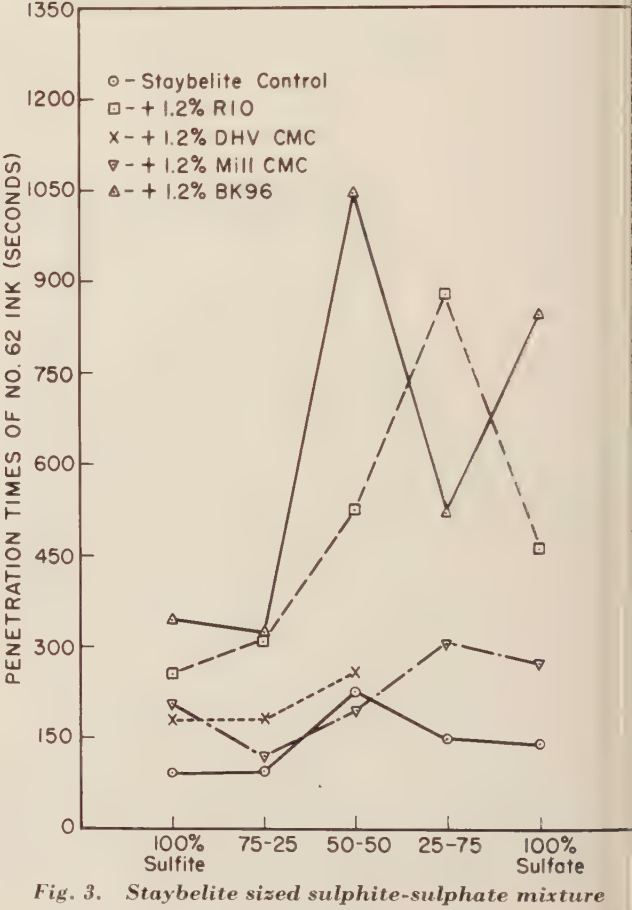

Fig. 3. Staybelite sized sulphite-sulphate mixture

In formulating a size test solution it was found that solution of a dye required too long a penetration time t

Table III. Penetration of Wetting Agent Solutions

Agent	*Type*	*Penetration time, sec.*
Ninol 737	Cationic	1
Polyglycol stearate	Nonionic	1800
Naccanol NR	Anionic	6

e useful, as such, for size testing. The obvious alteration in such a system was to add a wetting agent. As an be seen from Table III the cationic agent was too fficient and produced too short a penetration time. 'he nonionic agent that was tried did not appear to

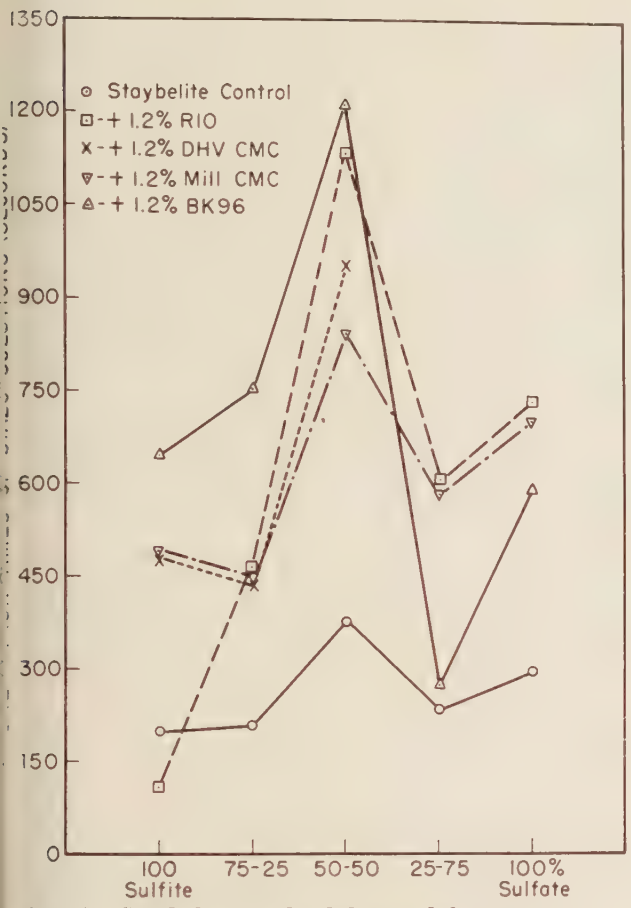

Fig. 4. Staybelite sized sulphite-sulphate mixture

sist in the penetration of water through paper. This ft the choice to be made from the numerous anionic gents.

A blue dye was selected for the test ink because of the ntrast in color with the white paper. Anthraquinone blue B proved to be satisfactory for this purpose. A series of inks was prepared with this dye that possessed varying surface tensions and pH conditions that were obtained, respectively, by adding different wetting agents and hydrochloric acid. The data presented in Table IV show the variation in the penetration times that were accomplished by altering the concentration of the ink, the pH condition, and the wetting agent. The concomitant differences in surface tension do not consistently explain some of the wide variations in penetration times. The series of inks prepared with Gardinol are particularly interesting in this respect. This wetting agent gave a high pH to the ink (11.5) and a very short penetration time. Reducing the pH to 2 lowered the surface tension but did not affect the penetration time. Dilution with an equal volume of water brought about a slight decrease in surface tension and a small increase in penetration time. Again diluting to twice the volume gave an ink with small change in surface tension, an appreciable increase in penetration time, and with it a pH condition nearly as high as the original ink, before acid was added. Another dilution to twice the volume (i.e., an original volume of 100 ml. was now diluted to 800 ml.) brought about no further change in either pH or surface tension but altered the penetration time to an impractical value of 780 sec. The similar alterations of the ink prepared with Tergitol 08 followed somewhat the same pattern except that the original unacidified ink gave high penetration times. Acidification reduces the pH from 11.45 to 1.6 and the respective penetration from 210 to 16 sec. Dilution to twice the original volume did not affect pH, raised the surface tension, and the ink gave very high penetration of 480 sec.

One ink was made up with a very strong cationic agent, Ninol 737, that had a pH and surface tension condition practically the same as the no. 19 ink made with Gardinol. However, instead of giving impractically high penetrations this no. 55 ink wet the paper so fast that the ink crept around the edge of the test sample and it sank in the ink before a penetration time could be obtained.

The ink prepared with Emulphor ON, acidified to a pH of 1.68 and with a surface tension of 43.5 dynes per sq. cm., produced reasonably good penetration times

Table IV

	Ink formulas				*Ink properties*		
No.	*Dye*	*Water, ml.*	*Acid*	*Wetting agent*	*pH*	*Surface tension*	*Penetration time, sec.*
15	Anthraquinone blue 1 g.	100	...	Gardinol 1 g.	11.5	32.5	1.4
16	Anthraquinone blue	100	HCl	Gardinol 1 g.	2.0	31.1	1.4
11	Pontamine blue	100	HCl	Nacconol NR	1.95	33.1	3.0
17	Anthraquinone blue	200	HCl	Gardinol	1.95	30.9	3.8
18	Anthraquinone blue	400	HCl	Gardinol	10.27	30.5	30.0
19	Anthraquinone blue	800	HCl	Gardinol	10.27	30.5	780.0
19A	Anthraquinone blue	800	HCl	Gardinol	1.68	30.5	300.0
20	Anthraquinone blue	100	...	Tergitol 08	11.45	40.9	210.0
21	Anthraquinone blue	100	HCl	Tergitol 08	1.60	35.3	16.0
22	Anthraquinone blue	200	HCl	Tergitol 08	1.60	40.2	480.0
37	Anthraquinone blue	100	HCl	Gardinol 0.06 g.	1.50	30.8	480.0
38	Anthraquinone blue	200	HCl	Gardinol	1.80	33.3	660.0
47	Anthraquinone blue	100	HCl	Aerosol OT 1 g.	1.40	29.6	[a]
55	Anthraquinone blue	100	HCl	Ninol 737 0.5 g.	1.58	29.0	[a]
61	Anthraquinone blue	100	HCl	Emulphor ON 1 g.	1.45	43.4	3
62	Anthraquinone blue	200	HCl	Emulphor ON	1.68	43.5	5
	Sanford's ink (lot no. 1)				1.60		540
	Sanford's ink (lot no. 2)						240
	Sanford's ink (lot no. 2)						300

[a] Solution crept around the edge of test paper and sample sank.

and differentiation between papers of known differences in sizing. A comparison with the diazo coating solution and an acid indicator test is shown in Table V.

Although it was stated earlier that size additives possessed no sizing properties in themselves but that their values consisted of improving the sizing efficiency of rosin size, nevertheless there appeared to be some

Table V

Engine sizing of paper	Penetration time, sec. Acid indicator	Diazo solution	No. 62 ink
Bewoid	100	13	15
Bewoid + 1.2% CMC no. 1	265	250	165
Bewoid + 5.7% CMC no. 1	230	165	360
Bewoid + 1.2% CMC no. 2	300	305	300
Bewoid + 1.2% CMC no. 3	200	180	80

specificity of various size additives toward some penetration test solutions. For example, CMC increased the penetration time for the diazo solution much more than for the substitute ink (which is referred to as no. 62 ink). A much greater difference in this same direction was exhibited by locust bean gum which produced high penetration times with the diazo solution and ev higher penetration with the no. 62 ink. Howeve derivative of locust bean gum showed no such spec sizing effect with the two test solutions.

These observations were made on sulphite pulp ha sheets. From brightness variations that occur from one lot of pulp to another and accompany variations in sizing efficiency, it was strongly suspect that the condition and possibly the type of papermak fibers, were important factors in not only rosin siz but also in size additive efficiency. This might w be determined by using fibers of such different chemi history as sulphite and sulphate pulps. A series handsheets was prepared from these types of pulp a varying mixtures of the two. One such series was siz with Bewoid and another sized with Staybelite si Using these two series as controls, another series w made in which different size additives were incorpora in the furnishes. The degree of sizing in the pap was measured by the penetration test using the 62 ink and the diazo coating solution.

The furnish schedules for these series of experime consisted of adding the size additive in a 1.2% of

Table VI. Sizing of Pulp Mixtures

Stock	Engine sizing	Size additive	Penetration time, sec. Diazo solution	No. 6 ink
100% sulphite	Bewoid	...	141	114
75% sulphite- 25% sulphate	Bewoid	...	112	103
50% sulphite- 50% sulphate	Bewoid	...	244	20
25% sulphite- 75% sulphate	Bewoid	...	208	173
100% sulphate	Bewoid	...	240	209
100% sulphite	Bewoid	R-10	411	555
75% sulphite- 25% sulphate	Bewoid	R-10	392	469
50% sulphite- 50% sulphate	Bewoid	R-10	743	102
25% sulphite- 75% sulphate	Bewoid	R-10	511	104
100% sulphate	Bewoid	R-10	710	89
100% sulphite	Bewoid	BK-96	521	575
75% sulphite- 25% sulphate	Bewoid	BK-96	466	481
50% sulphite- 50% sulphate	Bewoid	BK-96	883	1047
25% sulphite- 75% sulphate	Bewoid	BK-96	531	514
100% sulphate	Bewoid	BK-96	1340	1400
100% sulphite	Bewoid	CMC (mill)	484	196
75% sulphite- 25% sulphate	Bewoid	CMC	484	136
50% sulphite- 50% sulphate	Bewoid	CMC	692	218
25% sulphite- 75% sulphate	Bewoid	CMC	811	336
100% sulphate	Bewoid	CMC	543	409
100% sulphite	Bewoid	CMC DHV	617	154
75% sulphite- 25% sulphate	Bewoid	CMC	398	142
50% sulphite- 50% sulphate	Bewoid	CMC	668	220
100% sulphite	Staybelite	...	196	89
75% sulphite- 25% sulphate	Staybelite	...	208	98
50% sulphite- 50% sulphate	Staybelite	...	378	221
25% sulphite- 75% sulphate	Staybelite	...	233	146
100% sulphate	Staybelite	...	296	139
100% sulphite	Staybelite	R-10	111	253
75% sulphite- 25% sulphate	Staybelite	R-10	462	310
50% sulphite- 50% sulphate	Staybelite	R-10	1138	524
25% sulphite- 75% sulphate	Staybelite	R-10	606	880
100% sulphate	Staybelite	R-10	734	461
100% sulphite	Staybelite	BK-96	644	341
75% sulphite- 25% sulfate	Staybelite	BK-96	756	313
50% sulphite- 50% sulphate	Staybelite	BK-96	1216	1047
25% sulphite- 75% sulphate	Staybelite	BK-96	270	506
100% sulphate	Staybelite	BK-96	595	848
100% sulphite	Staybelite	CMC (mill)	491	205
75% sulphite- 25% sulphate	Staybelite	CMC	458	119
50% sulphite- 50% sulphate	Staybelite	CMC	844	199
25% sulphite- 75% sulphate	Staybelite	CMC	586	306
100% sulphate	Staybelite	CMC	702	273
100% sulphite	Staybelite	CMC DHV	480	176
75% sulphite- 25% sulphate	Staybelite	CMC	438	179
50% sulphite- 50% sulphate	Staybelite	CMC	955	259

dry fiber weight to 6 liters of 3% consistency pulp. Two milliliters of 12.5% alum solution was then added, followed by the rosin size in a quantity equal to 2% of the dry fiber weight. The system was aged for 1/2 hr. Then 5 ml. of 5% sodium aluminate was added, followed by 15 ml. of alum solution to bring the pH to approximately 4.5.

Under these furnish conditions it was found that rosin sizing was slightly more efficient with sulphate than with sulphite pulp. There appeared a tendency toward maximum sizing efficiency with a 50-50 mixture of these two pulps. However no generalization on the effects of the different pulps upon size additive efficiency was warranted. When Bewoid sized papers were tested with the no. 62 ink the sulphate fiber content was beneficial to sizing and size additive efficiency. When tested with the diazo solution this tendency was less well defined. The penetration times with both test solutions were more erratic for Staybelite sized papers. Under a different furnish schedule these relationships between fiber, size, size additive, and penetration test solution might be quite different.

In Table VI and Fig. 1, 2, 3, and 4 are given the penetration times for the ink and the diazo solution. Figures 1 and 2 show penentrations with Bewoid sized papers of varying fiber content and also containing various size additives. The additive R-10 is a carboxymethylated starch, BK96 a locust bean gum derivative, and the two CMC samples were from two different lots of the same viscosity type. Figures 3 and 4 show the comparable data for Staybelite sized papers.

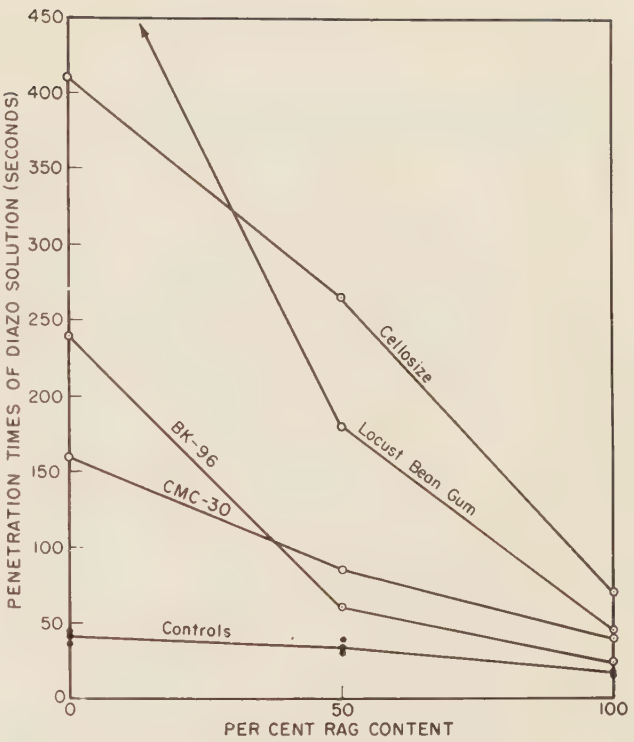

Fig. 5. Bewoid sized rag-sulphite mixture

Table VII. Sizing of Rag-Pulp Mixtures

Stock	Engine sizing	Size additive	Penetration time, sec. Diazo solution	Penetration time, sec. No. 62 ink
100% sulphite	Bewoid	...	51	44
100% sulphite	Bewoid	CMC-30	159	90
50% sulphite- 50% rag	Bewoid	...	29	28
50% sulphite- 50% rag	Bewoid	CMC-30	85	89
100% rag	Bewoid	...	27	23
100% rag	Bewoid	CMC-30	41	35
100% sulphite	Bewoid	...	51	44
100% sulphite	Bewoid	BK-96	240	248
50% sulphite- 50% rag	Bewoid	...	29	28
50% sulphite- 50% rag	Bewoid	BK-96	62	56
100% rag	Bewoid	...	27	23
100% rag	Bewoid	BK-96	26	24
100% sulphite	Bewoid	...	46	50
100% sulphite	Bewoid	Cellosize	411	253
50% sulphite- 50% rag	Bewoid	...	34	33
50% sulphite- 50% rag	Bewoid	Cellosize	266	270
100% rag	Bewoid	...	16	16
100% rag	Bewoid	Cellosize	70	76
100% sulphite	Bewoid	...	44	40
100% sulphite	Bewoid	Locust bean gum	596	280
50% sulphite- 50% rag	Bewoid	...	39	36
50% sulphite- 50% rag	Bewoid	Locust bean gum	181	141
100% rag	Bewoid	...	18	16
100% rag	Bewoid	Locust bean gum	45	37
100% sulphite	Staybelite	...	69	78
100% sulphite	Staybelite	Cellosize	263	423
50% sulphite- 50% rag	Staybelite	...	69	67
50% sulphite- 50% rag	Staybelite	Cellosize	169	265
100% rag	Staybelite	...	26	26
100% rag	Staybelite	Cellosize	127	162
100% sulphite	Staybelite	...	67	75
100% sulphite	Staybelite	Locust bean gum	265	256
50% sulphite- 50% rag	Staybelite	...	66	59
50% sulphite- 50% rag	Staybelite	Locust bean gum	181	176
100% rag	Staybelite	...	24	22
100% rag	Staybelite	Locust bean gum	86	82

This brings up several questions of rather controversial nature. The addition of alum before rosin sizing might well be challenged as well as the final furnish pH of 4.5. These results might also be discounted on the basis that white water was not recirculated into the deckle box. These criticisms were recognized and the furnish schedule and sheetmaking conditions changed for another series of experiments on mixed fiber paper. The author's work is primarily concerned with rag content papers so the next experiments to be described were with sulphite pulp and rag fiber mixtures. In these experiments no alum was added before the rosin size, the size was "set" or precipitated at a pH of about 5.5, and the final pH was adjusted to the same value. The size additive was added at a point corresponding to that which would be near the headbox of the machine. The handsheet machine was equipped with a reservoir to collect the drainage or "white water" from the sheet mold. This reservoir was designed to retain about half of the drainage water; the rest flowed out through an overflow pipe. In making handsheets the drain pipe from the sheet mold was filled with fresh water up to the screen. White water was pumped from the reservoir into the deckle box, the specified quantity of 1% pulp furnish added, and the sheet was then formed on the wire. The first five sheets, thus made, were discarded. It was found that in making these first

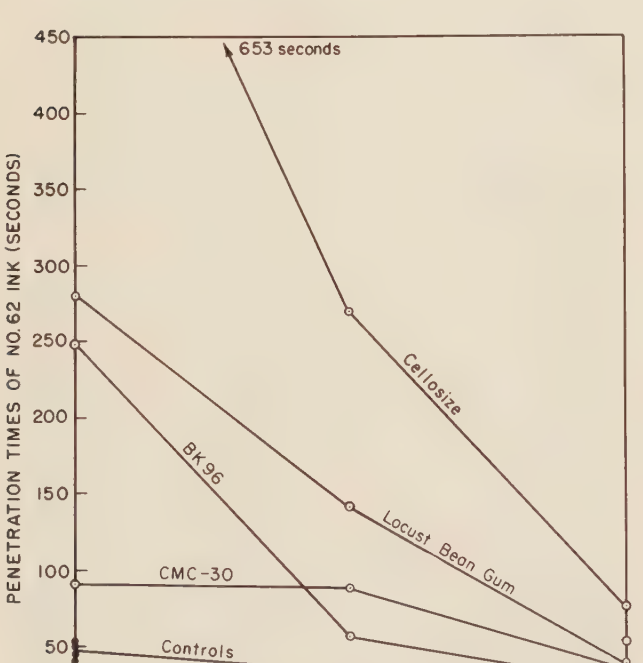

Fig. 6. Bewoid sized rag-sulphite mixture

five sheets the white water system had reached an equilibrium with fresh "make-up water," that is, the pH and the alum content had become fairly constant.

One further change in furnish preparation was made to bring laboratory conditions to more nearly those of the mill. This was in respect to the temperature of the rag stock when the beater is dumped. For this reas the sized furnish was held at about 50°C. for an ho before dilution to 1% consistency.

One series of experiments was based upon Bewo sizing of 100% sulphite pulp, a 50% mixture of sulphi and rag stock, and 100% rag papers. A similar seri

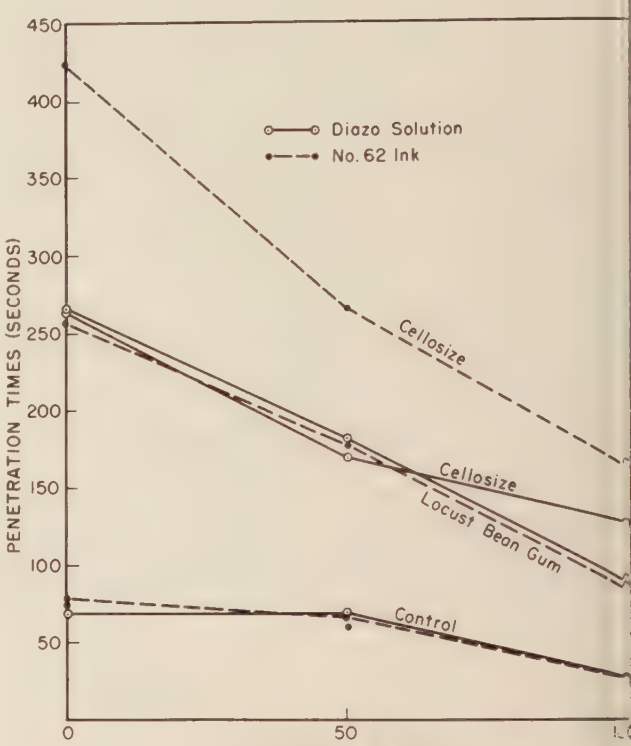

Fig. 7. Staybelite sized rag-sulphite mixture

was sized with Staybelite. The sizing of these vari papers was tested with both the diazo coating soluti and the no. 62 ink.

The penetration time data showed the usual loss sizing with increased rag fiber content of the pape (Table VII and Figs. 5, 6, and 7). A comparison this with the previous data all for the sulphite pu paper showed that the possible improvement wit higher furnish pH and the changed alum addition pr cedure was more than counterbalanced by the effect higher temperature and recirculated white water. Th combined effect of white water and rag fiber conte brought about an even more spectacular decrease in t efficiency of size additives than in the original ros sized control papers. This decrease was so mark that there might be some question concerning the use size additives with all rag papers. The greatest ben fits were obtained with the nonionic size additives, su as locust bean gum and Cellosize in these all r papers.

It thus appears that size additives can be a very us ful adjunct to engine sizing of wood pulp papers but t economy of their use in rag content papers may questioned. Not until we know why rag fibers beha so differently from wood pulps will size additives the panacea for the rag paper manufacturer.

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The Rind and Pith of Papyrus—An Analytical Study

LOUIS E. WISE and MOHAMMED A. EL-TARABOULSI

An orienting study was undertaken to provide chemical data, mainly a summative analysis of both the rind and pith of Egyptian "papyrus," the ancient "papermaking" material. Such data, obtained for the first time, may serve as a basis for some future work on the chemistry of certain constituents of the plant. The analytical data include percentage extractives, ash, acetyl, uronic acid, xylan, lignin, hemicellulose, and alpha-cellulose.

HISTORICAL INTRODUCTION

Most of the studies made on the various species of papyrus (from Egypt, Anglo-Egyptian Sudan, North and Rhodesia, Zululand, and Palestine) have involved pulping operations in order to find the suitability of each as a potential papermaking material. However, a complete summative analysis for most of these species is lacking. A systematic study of the constituents and the chemistry of the various components of papyrus is also rather meager. In one case, however, Hotoček (*1*) reported the presence of D-fructose and D-glucose in the hot-water extract of the parenchymatous tissue of *Cyperus papyrus* (from Italy), together with *d*-xylose and small amounts of glucosan from the hydrolysis products of the same tissue after the water extraction. A botanical microscopic study of papyrus has been made (*2–4*), and in general the plant seems to consist of fibers, sclerenchyma cells, parenchyma cells, vessels, and epidermal cells; the fibers are rather fine, short, and ranging between 0.5 to 3.0 mm. in length (average 1.7 mm.) and 0.008 to 0.025 mm. in diameter (average 0.012 mm.); the extremities of the fibers are pointed.

Papyrus has been pulped by different methods, the most satisfactory of which seem to be various types of alkaline pulping, either by the use of sodium hydroxide under pressure (*5–9*) or without pressure (*4*), or by cooking with lime (*10*). Mechanical pulping (*11–13*), sulphur dioxide pulping (*14*), and the conversion of papyrus into "half stuff" (*15*) have also been reported. Yields from the alkaline pulping are rather low (i.e., 35% yield of unbleached and 27% of bleached pulp). The resulting paper is usually hard, rattly, of good strength, and bleaches to a pale cream color. Evidently papyrus pulp is unsuitable for writing paper (*16*) but it can be used for making wrapping paper, compressed board for containers, and for building and insulating purposes (*17*). There seems to be a general agreement that the pithy material of papyrus has either little or no value as a papermaking material (*5, 17, 18*). Apparently pithy cells (parenchyma) in the pulp may cause shrinkage of the paper on drying and give rise to a stiff, parchmentlike sheet. They also hinder the bleaching process (*18*). It is claimed, however, that the pulp made from Northern Rhodesia's papyrus is superior in quality to that made from Egyptian and Zululand papyrus (*5*) despite the fact that the Rhodesian material contains about 80% of pithy material. It is also claimed (*17*) that papyrus from the Sudan is superior to other varieties since it contains less pithy material. This evidently is a point of disagreement. *Cyperus papyrus* (Egypt) and "Um Soof" (*Panicum pyramidale*) were suggested at one time (*19*) as a source of potash because the stem of the former contains 2.1% and the latter 2.3% K_2O (on the dry basis).

It is of interest that paper is still being made in small quantities from papyrus in Sicily, Italy, in two sizes, 33 by 44 cm. and 44 by 57 cm., and is on sale to tourists. The processes employed are similar to those used in ancient times (*20, 21*). However, a plant was established in South Africa in 1920 for making paper from *Cyperus papyrus* using modern pulping methods (*22*).

EXPERIMENTAL

Preparation of Samples for Analysis (Rind and Pith)

An 80-gram air-dry sample of Egyptian papyrus (*Cyperus papyrus* L.) was used in this work. The pithy material of the sample was separated from the rind as carefully as possible with the edge of a knife, and each was weighed separately. The pithy material accounted for 19.8% of the total. The pith and the rind were then reduced to meal by using a Wiley mill. The meal from the rind was screened and that passing a 40-mesh and retained by an 80-mesh screen was used for the analysis of the rind. Part of the meal from the pith (analysis 1) was bottled separately and the remaining part of the meal was screened to a 40 to 80-mesh sample (analysis 2), each specimen being analyzed individually. The various samples were stored in screw-capped bottles. Moisture determinations were made concomitantly with each analysis. Throughout the course of the study, moisture determinations showed only slight variations.

Orienting Qualitative Experiments

The Nature of Carbohydrates in Pith and Rind. The carbohydrate components of the rind and pith were qualitatively identified by the use of paper partition chromatography.

A 2-gram sample (from each of the pith and the rind), previously extracted with ether, alcohol-benzene, and cold water, was hydrolyzed at room temperature with 72% sulphuric acid for several hours, diluted with water to bring the acid mixture to 3% concentration, and boiled for several hours under a reflux condenser. The boiling suspension was neutralized with barium carbonate and filtered; the clear filtrate was acidified very slightly with acetic acid and concentrated to a thin sirup, which was then submitted to paper partition chromatographic analysis by the method of Wise, Green, and Rittenhouse (*23*) using a 4 by 22-in. What-

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man no. 1 paper. Two paper chromatograms were made for each sirup using two different developers and different times of developing. The results are given in Table I.

Table I. Identification of Sugar Units

Material[a]	*Sugars identified*[b]	*Sugars identified*[c]
Rind	Glucose (strong)	Glucose (strong)
	Xylose (strong)	Xylose (strong)
	Arabinose (?)	Arabinose (small amounts)
Pith	Glucose (strong)	Glucose (strong)
	Xylose (strong)	Xylose (strong)
	Arabinose (?)	Arabinose (small amounts)
		Galactose (?)

[a] Tests for starch were negative.
[b] Developer: ethyl acetate, acetic acid, water (9:2:2); time of development, 24 hr.
[c] Developer: Pyridine, *n*-butanol, water (3:10:3); time of development, 48 hr.

Modified Mäule Reaction (24) for Syringyl Groups. When shaken with chlorine water for a few minutes, followed by treatment with aqueous sodium sulphite, the pith and rind gave a nondescript yellowish-red color which lay somewhat between the color given by hard and softwoods. Thus the test proved to be of questionable value.

Analytical Procedures

Ash Determination. The weighed oven-dry samples were charred very carefully and then heated to constant weight over a Bunsen burner. Results are shown in Table II.

Table II. Ash Components

	Ash, % (*on unextracted, oven-dry material*)	*Ash, %* (*on extracted, oven-dry material*)
Rind	4.65	2.75
Pith	5.35	3.15

Extractives. Successive extractions were made using ether, alcohol-benzene, and cold water, and the extracts from both the rind and the pith were determined by weighing the extract directly in each case, and also by determining the loss in weight, by difference, of the sample after the total extractions were made. The ether and alcohol-benzene extractions were made in a Soxhlet extractor, while the cold-water extraction was carried out in a beaker in three batches during a period of 24 hr. The results are recorded in Table III. In this and in subsequent tables, unless otherwise indicated, the results of duplicate analyses are given.

Table III. Extractives

Material	*Ether extract, direct weight, %*		*Alcohol-benzene extract, direct weight, %*		*Cold water extract, direct weight, %*		*Total extractives (average), %* *Loss in weight*	*Direct weight*
Rind	1.5	1.505	5.390	..	3.89	3.75	10.65	10.71
Pith	1.33	1.32	5.16	5.40	2.65	2.16	9.37	8.97

Lignin Content. The "Klason" lignin determination (*25*) was applied to the extracted pith and rind of papyrus by using 72% sulphuric acid followed by dilution to 3% and heating. In initial determinations the lignin was filtered on a Berlin crucible, but the filtration was very slow and time-consuming (24 hr. filtration). The results, however, showed a high degree of precisio (Table IV). In later lignin determinations it was foun expedient to filter the lignin on "balanced filter papers according to the method of Wise (*26*). This was muc faster (6 hr. were needed only for filtration and wash ings), and this also showed a fair degree of precisio (Table IV). The lignin in all cases contained a negligi ble amount of ash (0.1 to 0.2%).

Table IV. Lignin

(Corrected for ash; unextracted basis), %

Rind[a]	19.69	19.69
Pith[b]	16.02	16.21

[a] Filtration on the Berlin crucible (*25*).
[b] Filtration on ash-free filter paper (*26*).

Quantitative Isolation of the Alpha-Cellulose and Hemicellulose Fractions. Proximate determinations of alpha cellulose and hemicelluloses were carried out by firs preparing holocellulose and then isolating the two frac tions from this starting material. The chlorite proce dure was used in this work (*27*, *28*). The air-drie holocelluloses were weighed and extracted for 2 hr. a 20°C., with 100 ml. 5% aqueous potassium hydroxide with occasional shaking. The suspension was filtere promptly by suction into an excess of acetic acid, an the residue was then washed successively with 50 ml 5% potassium hydroxide, with water, and finally wit dilute acetic acid and water. The filtrate and washing (which were strongly acid) were then treated with 4 t 5 volumes of 95% ethanol to precipitate the hemicellu lose (fraction A). The fibrous residue, after aceto washing, was air-dried and extracted with 100 ml. 16% potassium hydroxide as before. The suspension wa again filtered into an excess of acetic acid, and wash successively with 50 ml. of 16% potassium hydroxi water, 10% acetic acid, and water. The filtrate wa precipitated by means of an excess of alcohol, thus gi ing hemicellulose (fraction B). The two hemicellulos fractions were combined. The insoluble fibrous residu from these extractions was the "alpha-cellulose," whic was only corrected for ash.

Table V. Alpha-Cellulose Content

(Corrected for ash; unextracted, oven-dry basis), %

Rind	39.85	39.40
Pith	40.25	40.60

The combined flocculent, hemicellulose fractions wer centrifuged and washed thoroughly with warm 95% al cohol, absolute alcohol, and anhydrous ether. Th white powdery products were then dried to constan weight at 100°C. Ash determinations were made o the various hemicelluloses by careful charring and ig nition in the presence of a few drops of concentrate sulphuric acid. The "sulphated ash" was then weighe and extracted repeatedly with hot water. The wate insoluble residue was also determined. The entir water-soluble ash was assumed to be present as potas sium sulphate, with the further assumption that th potassium in this ash has been present originally in th form of —CO·OK in the uronide portion of the hemi cellulose fraction (*29*). The soluble sulphated as was calculated to potassium for which due correctio

vas made. A correction was also made for the insolule ash in the hemicellulose. The corrected values (*29*) of the hemicellulose are given in Table VI.

Table VI. Hemicellulose
(Corrected for ash; unextracted, oven-dry basis), %

Rind	21.21	20.70
Pith	24.90	24.85

Acetyl. The acetyl groups are assumed to be associated largely with the hemicelluloses (presumably the xylans). Accordingly, sometimes the acetyl contents are added to the total hemicellulose contents. In this case they have been treated separately. Table VII gives the acetyl values.

Table VII. Acetyl Content
(Unextracted, oven-dry basis), %

Rind	4.08	4.15
Pith	4.72	..

Uronic Anhydride Content. Uronic acids are usually present in a polymerized form either in the hemicellulose or as pectic materials. The method used for their determination was that of Browning (*30*). Table VIII gives the values of uronic anhydride content.

Table VIII. Uronic Anhydride Content
(Unextracted, oven-dry basis), %

Rind	6.98
Pith	
Uronic Anhydride Content of the Hemicellulose	
Rind	18.45
Pith	16.6

Pentosans; Estimation of Xylan Content. Preliminary chromatographic data indicated that both the rind and the pith contain appreciable amounts of xylan and only subordinate amounts of arabans. Pentosans were converted into furfural by distilling with 12% hydrochloric acid under standardized conditions. Furfural was then determined as the phloroglucide (*31*), from which the pentosan content was calculated by the use of Kröber's tables (*32*). Inasmuch as uronic acids and polyuronides also yield a certain amount of furfural when distilled with hydrochloric acid, suitable corrections should be made for this additional furfural. Empirical corrections (*29*) were applied, and the corrected phloroglucide values were then converted into the corresponding xylan values as seen in Table IX.

Table IX. Xylan

	Uncorrected, %	*Corrected for uronic anhydride,* %
Rind	18.79	17.4
Pith	...	...
Hemicellulose (rind)	69.15	64.0
Hemicellulose (pith)	67.6	62.25

A summation of analytical data is given in Table X.

Physical Data

Degree of Polymerization. Staudinger and Feuerstein (*33*) reported a degree of polymerization for papyrus of 1870 to 2040. In the present work the D.P. of the alpha-cellulose that had been extracted from the rind holocellulose was determined. The alkaline extraction of the alpha-cellulose was carried out in the presence of air (not nitrogen) under which conditions the fibrous material was probably severely degraded. The average D.P. of the alpha-cellulose as determined by the nitrate method (*34*) was 656.

Table X. Summative Analyses of Papyrus
(Unextracted, oven-dry basis), %

Types of analysis	*Rind*		*Pith*	
Ash	4.66	4.64	5.35	5.35
Total extractives	10.78	10.65	9.14	8.88
Acetyl	4.08	4.15	4.72	4.72
Lignin (corrected for ash)	19.69	19.69	16.02	16.21
Alpha-cellulose (corrected for ash)	39.85	39.40	40.25	40.60
Hemicellulose (corrected for ash)	21.21	20.70	24.90	24.85
Total	100.27	99.23	100.38	100.61
Average	99.75		100.09	

Fiber Dimensions. The unextracted rind and pith were macerated with acetic anhydride and sodium chlorite according to the method of Isenberg (*35*). The ultimate fibers did not separate after one chlorite treatment, and the process was repeated five times but with no success. After the chlorite treatment, however, as soon as the rind and the pith were treated with dilute alkali, the structure immediately collapsed and maceration to the ultimate fibers was easily effected. The fiber dimensions were determined under the microscope with the aid of an eye micrometer. It should be noted that the maceration method used was rather drastic and the values obtained should be regarded with caution.

Rind: The length of the fibers ranged from 0.29 to 0.7 mm. (average 0.5 mm.); the diameter ranged from 0.005 to 0.01 mm. (average 0.007 mm.).

Pith: The length ranged from 0.1 to 1 mm. (average 0.45 mm.); the diameter ranged from 0.005 to 0.008 mm. (average 0.006 mm.).

DISCUSSION

Complete summative analyses of both the rind and pith of Egyptian "papyrus" are presented for the first time. Of interest is the relatively high hemicellulose content of the pith, which was used by the ancients for making paper. The question arises about the importance of the role played by the hemicellulose in cementing and holding the fibers together in the ancient papermaking process. In that respect it is of interest to note the great resistance to maceration of the pith and the rind (in the chlorite treatment) and the immediate collapse of the structure on extracting the hemicellulose with alkali. This is rather an abnormal phenomenon when compared with the behavior of different species of wood (*35*). Future studies of the chemistry of these hemicelluloses should prove to be of interest.

From the pulping point of view, papyrus has a somewhat low lignin, fair alpha-cellulose, and "normal" hemicellulose content, but on the other hand, the di-

mensions of the cellulose fibers are rather unsatisfactory from the papermaker's point of view. However, statements regarding the usefulness of the plant for pulping purposes cannot be made without actual pulping experiments.

LITERATURE CITED

1. Votoćek, F., *Collection Czechoslov. Chem. Commun.* 9: 126-133 (1937).
2. Vidal, L., *Paper Making* 29, No. 8: 297–299 (Aug., 1910).
3. Fournier, R., *Papier* 23, No. 8: 178–180; No. 9: 197–200 (Aug., Sept., 1920).
4. Fournier, R., *Papeterie* 43: 387–392 (1921).
5. *World's Paper Trade Rev.* 92, No. 1: 1–2 (1929); *Paper-Maker* (*London*) 78, No. 2: 169–170 (1929).
6. Vidal, L., and Aribert, M., *L'Agronomie Coloniale* 6: 234 (1922); *Bull. Imp. Inst.* 21: 396 (1923).
7. Vidal, L., and Aribert, M., *L'Agronomie Coloniale* 6: 53 (1921); *Bull. Imp. Inst.* 19: 18–20 (1921).
8. Norton, J. S., and Wirtz, Q., *World's Paper Trade Rev.* 47: 737–742 (May, 1907).
9. Selleger, E. L., *Paper Making* 26, No. 2: 65 (Feb., 1907).
10. Wells, J., British pat. 120,086 (Oct. 24, 1917).
11. Steinhilber, H., Brit. pat. 179,885 (June 21, 1921).
12. Steinhilber, H., Brit. pat. 180,097 (March 3, 1921).
13. Hoering, P., Brit. pat. 6,971 (March 19, 1914).
14. Dorner, B., Brit. pat. 316,413 (July 7, 1928).
15. Beam, W., *Wellcome Trop. Res. Lab. Chem. Section, Bull.* 2: 4 pp. (1915).
16. *Bull. Imp. Inst.* 18: 323–335 (1920).
17. Barkworth, G. E., and Coomber, H. E., *Bull. Imp. Inst.* 44, No. 4: 279–286 (Oct.–Dec., 1946); *Paper-Maker* (*London*) 114, No. 1: 12, 14, 16 (July, 1947).
18. *Bull. Imp. Inst.*, 17: 152 (1919).
19. Joseph, A. F., and Martin, F. J., *J. Soc. Chem. Ind.* 3 No. 7: 91–94T (1920).
20. Wiede, J., *Paper Maker* 34, No. 9: 309–315 (Sept., 1907).
21. Alibaux, H., *Wochbl. Papierfabrik* 70, No. 11: 241–2 (March 18, 1930).
22. Heyerdahl, E. F., *Papir Journalen* 8: 145–147 (1920).
23. Wise, L. E., Green, J. W., and Rittenhouse, R. C., *Tap* 32, No. 7: 335 (July, 1949).
24. Mäule, C., *Beitrage Wiss. Bot.* 4: 166 (1900).
25. Institute Method No. 13, January, 1951.
26. Wise, L. E., *Chemist Analyst* 36, No. 1: 8–9 (Feb., 1947).
27. Jayme, G., *Cellulosechemie* 20: 43 (1942).
28. Wise, L. E., Murphy, M., and D'Addieco, A. A., *Pap Trade J.*, 122, No. 2: 35 (Jan. 10, 1946).
29. Wise, L. E., Rittenhouse, R. C., and Garcia, C., *Fore Products Research Soc.* 5: 239–255 (1951); *Tappi* 34, N 4: 185–188 (April, 1951).
30. Browning, B. L., *Tappi* 32, No. 3: 119–120 (March, 1949)
31. Bray, M. W., "Methods Used at the Forest Products La for the Chemical Analysis of Pulps and Pulpwoods" page 3 Sept., 1939.
32. Kröber, E., *J. Landw.* 48: 357 (1900); 49: 7 (1901).
33. Staudinger, H., and Feuerstein, K., *Ann.* 526, No. 1: 72–1 (1936).
34. Alexander, W. J., and Mitchell, R. L., *Anal. Chem.* 2 No. 12: 1497 (Dec., 1949).
35. Spearin, W. E., and Isenberg, I. H., *Science* 105, No. 272 214 (Feb. 21, 1947).

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Suitability of Wood Pulp for Acetylation

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Work at the Benger Laboratory of the Du Pont Co. has shown that the evaluation of pulp can be separated into two distinct parts. The first of these, pulp processability in acetylation, can be carried out rapidly and conveniently by the pulp manufacturers while the second, determination of cellulose acetate quality, usually requires the spinning of yarns by highly specialized techniques and with apparatus which is commonly found only in the acetate industry. This paper discusses a laboratory method for determining the suitability of a pulp for acetylation.

During the past 15 years, the cellulose acetate industry has become an increasingly important consumer of wood pulp cellulose. The late entry of wood pulp into this field is probably attributable to the difficulties of evaluating its suitability for acetylation. Because of the complexities of commercial acetylation practice and differences in specifications of cellulose acetate for film, plastics, and yarns, the testing of acetylating wood pulps has been largely left to the cellulose acetate manufacturers. As a result, the rate of progress in development of acetylating pulps has been primarily dependent upon the facilities of the consuming, rather than the producing, industry.

The consumer's testing of candidate pulps has usually involved the production of cellulose acetates by one particular method and the suitability of the pulp for acetylation has been reported by description of the processing difficulties (or lack of them) which were encountered and the quality of the yarns or films ul mately produced. The methods for evaluation whi have been made available for use by the pulp manufa turers usually expressed the suitability of the pulp acetylation only in terms of the quality of cellul acetate flake produced by the specific method. B cause a large number of factors are considered simu taneously, no simple objective expression for usefulne of the pulp can be given. In general, these metho require the use of rather complicated techniques ar expensive apparatus, which has done much to limit the use by the pulp and paper industry.

There are three parameters important to the proces ability of wood pulp in acetylation: (1) the over-a rate of reaction, (2) the rate of degradation of t cellulose acetate being produced, and (3) the rate disappearance of filter-plugging particles during ace ylation.

The first of these quantities, the over-all rate of r action, is important because it determines the rate which the reaction mass must be cooled, on the one han and the productivity of equipment, on the other. T second of the processability factors, rate of degradatio is of the greatest importance because the final degr of polymerization determines the physical properti of the yarns and films made from the cellulose acetat Therefore, it is necessary to discontinue the reaction a given degree of polymerization, regardless of the f terability of the resulting product. The filterability the product is of direct economic importance since determines the kind and extent of processing that t cellulose acetate must receive prior to spinning. F the reasons indicated, a screening test has been deve

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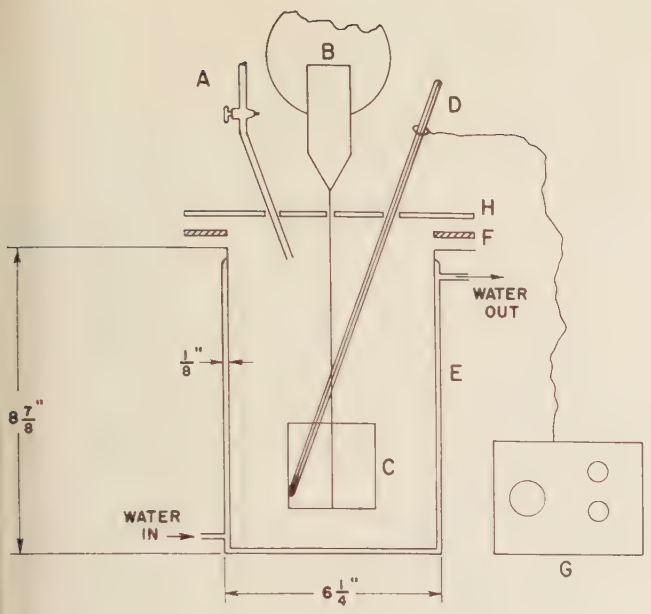

Fig. 1. Reactor assembly

A, bottom portion of anhydride metering device. B, electric motor, 1800 r.p.m. full speed. C, three-bladed stainless steel stirrer. D, thermometer and "Thermocap" clamp. E, reaction kettle. F, 1/8-in. polythene gasket. G, "Thermocap" relay. H, plate glass top.

oped which is capable of describing the suitability for acetylation by these three terms.

The method involves periodic determination of the concentration of filter-plugging particles and the viscosity of the acetic acid solution during the latter stages of acetylation. These values are then plotted against each other to give what is termed a quality curve, which is highly reproducible and capable of predicting the results of commercial scale acetylations. To obtain high sensitivity, this method uses only 1.9% sulphuric acid catalyst (based on cellulose) as contrasted to the 20% use in the acetylatability test of Jayme and Schenck (*1, 2*). Low consistency has been found essential not only to insure isothermal reaction conditions but to provide, finally, a cellulose acetate solution of sufficiently low concentration that the viscosity adequately describes the degree of polymerization.

Prior laboratory tests (*1, 2*) for the suitability of acetylating pulps have usually relied upon turbidity measurements and insoluble residues for the quantitative description of the test results. Both turbidity and insoluble residues, however, are a measure of factors other than plugging particles. The cellulose acetate formed, for example, from pulps high in pentosans and displaying high turbidity in acetic acid solution is often quite easily filterable and of acceptable viscosity. In other cases pulp has been found to contain a small percentage of fibers which acetylate so slowly that they never swell strongly in the reaction media and thus leave much insoluble residue but do not markedly affect filterability. On the other hand, high alpha pulps which have been dried to very low moisture contents will give quite clear solutions, relatively free of insolubles, yet be entirely unacceptable because of poor filterability. The substances responsible for the haze and insoluble residues thus may have no effect on the processability of wood pulp in acetylation, although they may limit the suitability of the cellulose acetate for certain end uses.

APPARATUS AND REAGENTS

Figure 1 shows the water-jacketed stainless steel reactor assembly with the stirring unit, temperature control, and reagent metering device in place. The top is of safety glass and made to specification by the Pittsburgh Plate Glass Co. The vessel is heated by water pumped from a constant temperature bath maintained at a given temperature. After the reagents are added, the inlet tube is removed and the opening stoppered.

Figure 2 shows a diagram of water flow and the temperature control system. Solenoid valves A, B, C, and D are controlled by the "Thermocap" relay. The constant temperature bath is maintained at a temperature slightly above 55°C. The exact temperature is, of course, determined by the heat losses in any given system.

The following reagents are used during the acetylation reaction.

Acetic acid (f.p. = 16.3°C. or higher) It is important that this be of constant quality and contain less than 0.2% water.
Sulphuric acid C.P., ACS.
Acetic anhydride C.P. It is important that this be of constant quality and contain no more than 0.3% acetic acid.
Sodium carbonate C.P.
Karl Fischer reagent.
0.5 *N* NaOH.

The acetylation procedure can be broken down into the following steps: (1) disintegration of dried pulp or extraction of moisture from undried pulp, (2) activation, (3) acetylation, and (4) sampling and catalyst neutralization.

PROCEDURE

The acetylation is so devised that either a machine-dried pulp or an undried pulp can be used. When a machine-dried sample is used, the pulp is preferably stored in a constant humidity room at 65% R.H. and 75°F. for at least a week before use. Pulp sheets are torn into 1 1/2-in. squares before storage. This conditioning allows the sample to reach a moisture level of 7 to 8%. In using a machine-dried pulp, care is taken that such pulp has never been dried lower than 5% moisture, since Jayme and Schenck (*1*) indicate that overdrying leads to "irreversible hornification" and to production of acetates of extremely low filterability.

Conditioned machine-dried pulp is analyzed for moisture content by Fischer reagent (*3*). The per cent moisture is calculated and a starting weight of pulp

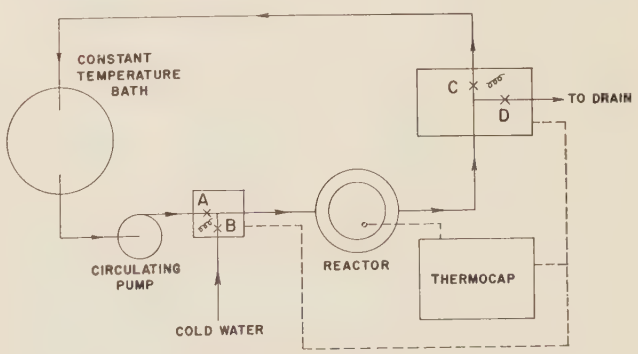

Fig. 2. Diagram of temperature control system

equivalent to 70.4 grams of moisture-free cellulose is used. The pulp is placed in the stainless steel reactor and 1500 grams of the glacial acetic acid are added. The reactor top is fastened and the pulp broken up by stirring. After the pulp sheet is completely disintegrated, the slurry is transferred to a Buchner funnel and filtered. A rubber dam is used toward the end of the filtration period to remove the acetic acid as completely as possible. The filtered cellulose is transferred to a previously weighed 3-liter wide-mouthed bottle and filtrate is added until the bottle contains the original conditioned pulp weight plus 360 grams. A 20-ml. portion of the filtrate is titrated for moisture. The total amount of water removed from the pulp during disintegration is calculated and added to the pulp. The bottle is stoppered and placed on a set of mixing rolls at 25°C. for 30 min. or until the pulp is completely disintegrated.

When an undried pulp sample is used, for example, to distinguish the effects of drying from other preparative variables, the wet pulp is washed three times by stirring with 1500-gram portions of glacial acetic acid and filtered after each washing. After the final washing, the pulp is filtered as dry as possible on a Buchner funnel using a rubber dam. Samples are removed and analyzed for moisture content by Fischer reagent and for acetic acid content by titration with 0.5 N (normal) sodium hydroxide. From these analyses, the cellulose content is determined and the correct amount of pulp mat to give 70.4 grams of moisture-free cellulose is weighed into a 3-liter bottle. The total acetic acid present in the mat is determined and additional acid added so that there will be 360 grams of acetic acid present.

After the temperature of the bottle has reached 25°C., it is removed from the rolls and 50 ml. of catalyst solution are added. The catalyst solution is a stock solution of sulphuric acid in glacial acetic acid. This solution is conveniently prepared from 133.0 grams sulphuric acid and 5117 grams glacial acetic acid and may be titrated with 0.1 N anhydrous sodium acetate in glacial acetic acid using 0.1% crystal violet indicator in glacial acetic acid. The solution is adjusted to 0.0265 ± 0.0001 gram H_2SO_4 per ml. measured at 25.0 ± 0.1°C. For such solution $d_{4.0}^{25.0} = 1.061$. The catalyst is kept in a 25 ± 0.1°C. constant temperature bath and is delivered from an atomatic 50-ml. pipet. Upon addition of catalyst, the bottle is returned to the rolls for a 72-min. period and is maintained at 25°C.

During the tumbling period, the correct amount of acetic anhydride and additional acetic acid is weighed out. About half the acetic acid to be used is placed in the reactor and the temperature raised to 45°C.

The amount of acetic acid and anhydride to be added is determined from the following equations:

$$\text{Acetic acid (in grams)} = (-6.665)(70.4 + \text{grams } H_2O \text{ present in pulp}) + 1712.6 \quad (1)$$

$$\text{Acetic anhydride (in grams)} = (5.665)(70.4 + \text{grams } H_2O \text{ present in pulp}) - 245.1 \quad (2)$$

These equations correct for the moisture present in the pulp so that each acetylation has for 70.4 grams of cellulose 153.7 grams of anhydride and a total 1243.4 grams of acetic acid diluent present at the start of the acetylation reaction.

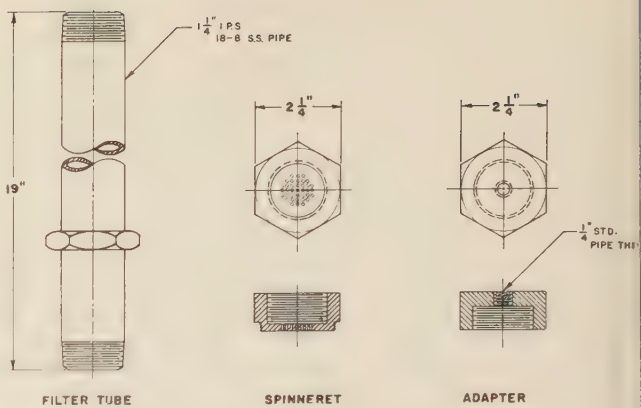

Fig. 3. Filtration tube and attachments

At the end of the 72-min. activation period, the bottle is removed from the rolls and transferred to the reactor. The remaining acetic acid to be added to the reaction is used to rinse the tumbling bottle before addition to the reactor. Three minutes after the tumbling period, the stirrer is started and acetic anhydride is added at the rate of 40 ml. per min.

A stopwatch is started at the beginning of the anhydride addition. The temperature is allowed to reach 55° in 5 to 8 min. In general, sampling is begun 5 min after the bottom of the reactor is visible through the reaction mixture. For a normal machine-dried acetate pulp of 7 to 8% moisture, the first sample is collected 85 min. after the beginning of acetylation by withdrawal into a tared bottle. The schedule for the other samples depends upon the appearance of the first sample. Until the knack of sampling is developed, as many as seven samples can be withdrawn 5 to 10 min apart. For a normal run, five 300 to 350-gram samples are sufficient. All samples are weighed and the proper amount of sodium acetate "stopping solution" is added immediately after the sample is taken, to neutralize the sulphuric acid catalyst, and the time of "stopping" is noted. The sodium acetate solution is made by dissolving 1.16 grams of anhydrous sodium carbonate in 102 ml. of glacial acetic acid. For each 100-gram sample of "gum," 5.33 ml. of solution (a fourfold excess) is used to neutralize the catalyst. The solution is measured from a buret at room temperature. With collection of samples, the acetylation is concluded and the samples are allowed to cool to room temperature.

SAMPLE EVALUATION

With the exception of the filtration assembly, the equipment used for sample evaluation can be purchased from chemical supply houses. Figure 3 shows a diagram of the filtration tube assembly. The filter tube is a stainless steel pipe 19 in. long with a $1^1/_4$-in. internal diameter. The spinneret head is a perforated stainless steel hexagonal nut threaded to fit the end of the filter tube.

The concentration of filter-plugging particles in the sample solution is determined by application of the Hermans and Bredee standard filtration law (*4*).

It has been shown by these authors that equation (3) holds for cellulose xanthate solutions:

$$\frac{t}{V} = \frac{k}{2}t + b \quad (3)$$

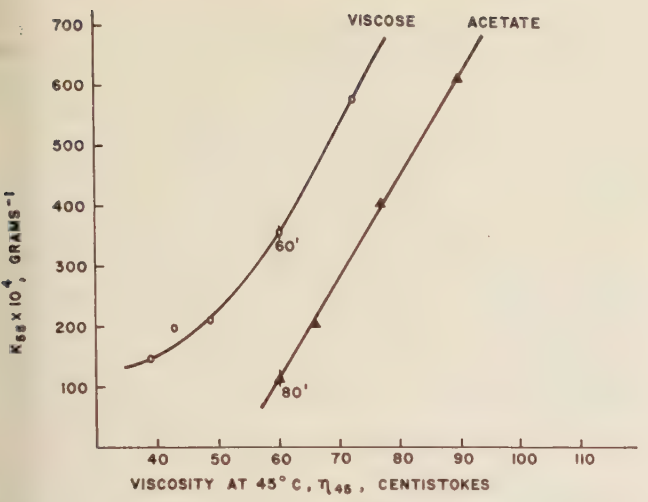

Fig. 4. Acetylation data: sulphite process, viscose and acetate pulps

$$\frac{t}{W} = K_p t + b' \qquad (4)$$

$$\frac{1}{W} = K_p + \frac{b'}{t} \qquad (5)$$

when $t \rightarrow \infty$ then (5) becomes:

$$\frac{1}{W} = K_p \qquad (6)$$

Here t is time required for V ml. of filtered solution to pass through a filtered medium. If V is converted to W, weight of solution, then equation (4) results. Dividing through by t yields equation (5). If the filtering medium is plugged, t is infinite and the reciprocal of the weight of the filtered solution is equal to K_p which is called the filter-plugging constant (6). Alternatively, K_p can be determined according to equation (4) as the slope of the line obtained by plotting t/W against t. This constant is thus a measure of the concentration of particles in the solution which can plug a filter of a particular porosity. These equations have been found to describe satisfactorily the filtration behavior of cellulose acetate solution.

The filter-plugging constants are obtained by pouring 250 to 300 ml. of the gum into a filter tube and filtering it at a nitrogen pressure of 60 p.s.i. until the paper is completely plugged. In the event that seven samples have been taken, less than 250 ml. can be used. The spinneret nut is packed with a filter ring against the spinneret face, a 200-mesh stainless steel screen, calibrated filter paper, a stainless steel ring, and a polythene gasket. The filter paper is calibrated at atmospheric pressure by pouring 450 ml. of acetone (0.25% moisture) in a filter tube and noting the time required for 400 ml. of the acetone to flow through the paper. This time is noted on the margin of the paper and if more than 55 ± 15 sec. the paper is not used. If the paper is within the limits, it is allowed to dry for use in the filterability test.

As stated previously, the reciprocal of the weight of filtered gum is the plugging constant for that particular paper of a certain acetone porosity. The filter-plugging constant is corrected to comparable values through the use of the equation (7) which is based on a 55-sec. paper.

$$\frac{K_x}{K_{55}} = 0.012717X + 0.3006 \qquad (7)$$

where X = paper porosity as measured by seconds to pass 400 cc. of acetone.

The viscosity of the filtrate from the determination of the plugging constant is measured at 45°C. in an Ostwald-Fenske viscometer.

The tubes are filled with filtered gum solution in a standard manner by inverting and filling to the top flow mark. The viscosity of the gum solution is measured at 45 ± 0.1°C. in a series 300 pipet and the value reported in centistokes.

TREATMENT OF DATA

Filter-plugging constants corrected to a 55-sec. paper value are plotted against the viscosity values for each sample. The curve obtained is compared with a curve obtained for a pulp known to give good results in the acetylation reaction. The displacement of this curve from the standard curve is a measure then of the pulp behavior. If the curve falls above the standard, the pulp tested is worse than the standard pulp; if the curve falls below the standard, the pulp is a better pulp for acetylation.

This test lends itself very easily to routine use since tables or graphs can be made that enable the operator of the test to make very few calculations. With these aids, the test can ordinarily be completed in 6 hr. and can be handled by a worker without technical training.

EXPERIMENTAL RESULTS

The standard laboratory acetylation procedure was developed primarily for the evaluation of commercial dissolving pulps and a variety of experimental acetate pulps for possible use in the manufacture of cellulose acetate. The inherent differences in various types of wood pulp as to processability in acetate manufacture are illustrated in Fig. 4, which shows "quality" curves resulting from the laboratory acetylation of a commercial sulphite process acetylating pulp (curve a), and a commercial sulphite pulp used for production of viscose rayon (curve b). These curves show typical differences in processability of these two types of pulps and predict accurately the processing difficulty encountered in the acetylation.

The pulp designed for acetylation reached a plugging constant of 100 × 10^{-4} at a viscosity of 60 cs. This is quite an acceptable performance. The pulp designed for xanthation gives a plugging constant of 350 × 10^{-4}

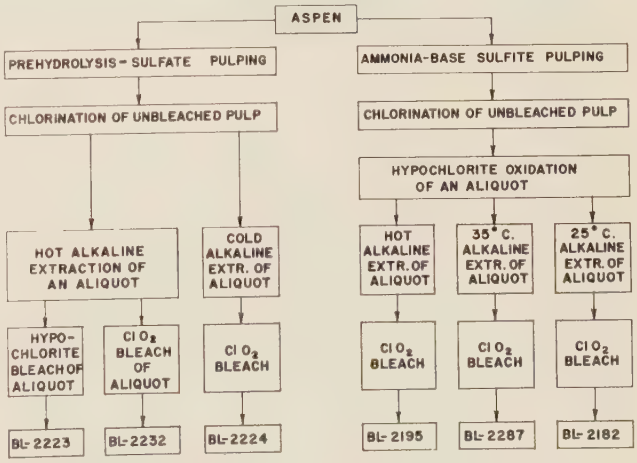

Fig. 5. Preparation procedures for aspen pulps

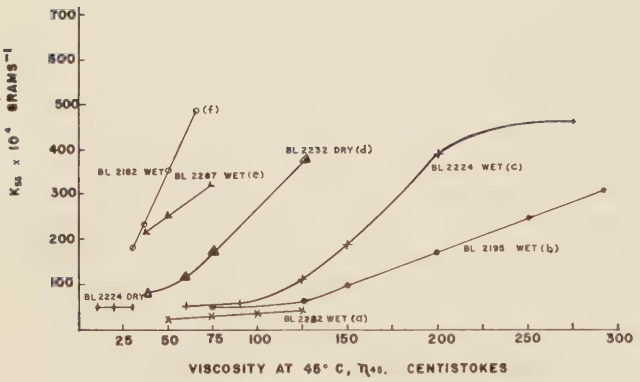

Fig. 6. Acetylation data: experimental aspen pulps

at 60 cs. and would place an undesirable burden on the filtration system. Because these pulps are different in so many ways, only a systematic testing of pulping variables by the technique presented here permits conclusions, illustrated below, as to the factors responsible for the difference in performance.

This procedure is of particular value in choosing between alternative process conditions in development of a method of manufacture for acetylation pulps. An example of the application of this method to the evaluation of pulping processes is afforded by a study of a series of aspen pulps prepared by sulphite and prehydrolysis-sulphate process and submitted by the U. S. Forest Products Laboratory at Madison, Wis. The experimental procedures by which these pulps were prepared are described by Simmonds, Kingsbury, Martin, and Keller (*5*).

These samples were acetylated in the laboratory equipment and by the procedure described here.

Examination of the quality curves, Fig. 6, and preparation procedures, Fig. 5, for the various samples reveal the following facts:

1. Comparison of curves a and d shows that the drying conditions chosen for this sample have definitely deactivated the pulp. In order to eliminate the drying variables, the remaining samples were examined as wet pulps.

2. Since curves a and b are the same within experimental error, prehydrolysis-sulphate cooking product is equivalent to that from the ammonia-base sulphite process.

3. Since curves a and c are equal within experimental limits, hot and cold alkaline extraction are equally effective purification steps following a prehydrolysis-sulphate cook.

4. Since curve b is definitely better (lower plugging constant at a given viscosity) than either curve e or f, hot alkaline extraction is superior to cold alkaline extraction following sulphite pulping.

All of the aspen pulps reacted faster than a commercial acetylation pulp control, and some of the reaction mixtures reached the fiber-free stage in approximately one half the time required by a commercial acetylation pulp used as a control. Consequently, in the use of these pulps for the production of cellulose acetate a manufacturer would find it necessary to adjust his production cycles accordingly. The fact that many of the aspen pulp reaction mixtures reached the fiber-free stage at very high viscosities is desirable for commercial use since separation of the acetylation end point and the viscosity end point by an appreciable time makes for ease of control.

LITERATURE CITED

1. Jayme, G., and Schenck, U., *Cellulosechemie* 22: 54–56 (1944).
2. Heuser, E., Shockley, W., van den Akker, J., *Tappi* 32: 251 (1949).
3. Mitchell, J., and Smith, D. M., "Aquametry," page 205, New York, Interscience Publishers, Inc., 1948.
4. Hermans, P. H., and Bredee, H. L., *Rec. Trav. Chim.* 54: 680–700 (1935).
5. Simmonds, F. A., Kingsbury, R. M., Martin, J. S., and Keller, E. L., *Tappi* 36: 103(1953).

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Establishment of Correlations for the Three-Stage Bleaching of Semichemical and Sulphite Pulps and Blends Employing a Modified Permanganate Method

P. L. LEEMHUIS

A modification of the Wiles permanganate number test (TAPPI Standard T 214 m-50) has been developed. This modification took into account the problem of the ratio of permanganate to pulp sample weight when a very wide range of permanganate numbers was considered. Bleaching investigations, based on this modified test, were carried out on a series of mixed hardwood neutral sodium sulphite semichemical (N.S.S.C.) pulps of widely varying cooking degree, on some spruce sulphite pulps, and on several blends of these two types of pulps. Through the introduction of the permanganate number of the alkali-extracted pulp as a variable, the establishment of correlations for the first and the third stages of bleaching was made possible. In practical bleaching work, the use of separate correlations for the first and third stages proved advantageous, for it permitted compensation in the hypochlorite treatment for certain discrepancies encountered in the chlorination and alkaline extraction stages. A generalized graphical representation of the over-all three-stage bleach requirements for these pulps was made by combining the correlations for the first and third stages. The relationships established with these specific pulps were applied with discretion with a promising measure of success in some pulping investigations, in

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vhich conventional and unconventional pulping methods vere used, and which involved a number of individual iardwood species and various commercial blends of mixed iardwoods.

THE expanding commercial production of bleaching grades of hardwood neutral sodium sulphite semichemical pulps (hereafter referred to as N.S.S.C. pulps or the sake of brevity) has accented the need for a uitable bleach requirement test for these pulps. The precedent set by most reported research work is the use f the lignin content in the estimation of the chlorine equirements. In order to avoid the obvious difficulties f undertaking lignin determinations for process conrol, the problem is being met quite generally throughut the industry by various modifications of the usual leach requirement tests. Girdler (*1*) has described a leachability control test for highly lignified pulps. This method features a permanganate oxidation of a nechanically pretreated pulp sample and takes into ccount the problem of the ratio of the potassium ermanganate to the pulp sample weight for highly gnified pulps. Trout *et al.* (*2*) have detailed a modified ingle procedure for the quantitative determination of he lignin content of semichemical pulps.

A simple modification of the Wiles permanganate umber test has been in use for several years by this aboratory for the measurement of permanganate umbers covering a very wide range. In this paper, ome three-stage bleach control correlations are resented which are based on this modified test.

In the three-stage bleaching of hardwood N.S.S.C. ulps or blends of this pulp with spruce sulphite pulp, it ay be desirable to measure the permanganate numbers ot only of the component pulps, but also of the lended pulps. In addition, it has generally been found opropriate to determine the permanganate number of ne alkali-extracted pulp for guidance in the addition of ypochlorite in the final stage. These considerations dicate the desirability of a permanganate number test overing a range of from 0 to 70 or more. A problem ose in regard to the ratio of $KMnO_4$ to the pulp mple weight when such a wide range of permanganate umbers was considered.

ODIFICATION OF THE PERMANGANATE NUMBER TEST

Wiles (*3*) has suggested a procedure for pulps of very gh or very low bleachability. In this method, the uantities of $KMnO_4$ and H_2SO_4 were varied in proortion to the approximate pulp bleachability, always sing 1 gram of pulp and maintaining, by proper lution, the initial concentration of the reagents at 133 *N* H_2SO_4 and *N*/300 $KMnO_4$.

It appeared that the same fundamental conditions ould be met more simply if all factors were held variant with the exception of the pulp sample weight, hich factor would be varied in proportion to the pproximate pulp bleachability. The later scheme has en used as the basis for a modified permanganate umber method which has been employed in this work. or this method, it has proved practical to systematilly divide the permanganate number scale into ranges, each of which definite pulp sample weights have been ecified.

The ideal would probably be the use of a pulp sample weight so selected that the final concentration of $KMnO_4$ would be uniform; that is, so that an invariant back titration with the sodium thiosulphate would result. The permanganate number, determined in this way, should not suffer from discontinuity throughout the entire practical range. A possible scheme would involve a number of determinations employing different pulp sample weights. The permanganate number would be calculated from figures determined by interpolation of these results to the condition of invariant back titration with the sodium thiosulphate. Even with a high degree of discretion in the selection of the pulp sample weights by this scheme, probably three tests would be necessary for each pulp.

It appeared that a balance between the degree of continuity demanded and the simplicity and convenience of the method could be made quite practically by adjusting the sample weights so that the amount of $KMnO_4$ consumed is held within stated limits. A reasonably continuous relationship between permanganate number and chlorine requirement was found when the sample weights specified in Table I were used. On the specific basis defined by Table I, the consumption of $KMnO_4$ is automatically maintained in the range 32 to 64% of the amount applied, except for pulps with permanganate numbers over 64 or under 4.

The modified permanganate number is determined by the methods defined in TAPPI Standard T 214 m-50, using the instructions for the 25-ml. basic method, with the vital qualification that the pulp sample weights specified in Table I be employed. It has been found appropriate to measure the fractional gram pulp samples volumetrically from pulp slurries of known consistency of about 0.1 to 0.2%. The modified permanganate number is calculated by dividing the difference between 25 and the sodium thiosulphate back titration by the pulp sample weight in grams. In the following experimental work, permanganate numbers were determined exclusively by the described modified method.

EXPERIMENTAL

Cooking and Attrition Mill Treatment

A series of five mixed hardwood N.S.S.C. pulps, covering a range of cooking yields of from 57 to 76%, were prepared in an 0.8-cu. ft. laboratory autoclave equipped with a forced circulation system. The mixture of hardwood chips used in the preparation of these pulps was sampled from the mill chip conveyor.

Aspen N.S.S.C. pulps at two yield levels were also prepared, using for these a 0.4-cu. ft. autoclave not equipped with a forced circulation system. The details of both the mixed hardwood and the aspen N.S.S.C. cooks were recorded in Table II.

For identification purposes, crude cooking yields, and the permanganate numbers of the pulps, determined on the defibered samples that were reserved for the bleaching investigation, were included in the table. The temperature rise in every case was at the rate of 1°C. per min. from 70°C. to the maximum cooking temperature.

The defibering of the semichemical chips was carried out in a Sprout-Waldron 12-in. laboratory attrition

Table I. Pulp Sample Weights Used in the Determination of the Permanganate Number by the Modified Method

Sample weight, grams	*Permanganate No. range*
0.25	Over 32
0.50	16–32
1.00	8–16
2.00	Under 8

mill, modified to a speed of about 2600 r.p.m. and equipped with a hand-auger feed mechanism.

Following rough preliminary disintegrations, the cooking yields were determined. Each pulp was subsequently given two passes at a clearance setting of 0 mil and at a pulp consistency of about 3% in order to provide several samples of crudely defibered pulp. To provide more drastic defibering, each pulp was dewatered at the end of the second pass to a consistency of about 6% and given one or more passes at the higher consistency. At the end of each pass, a pulp sample was reserved for the measurement of freeness and permanganate number. The main body of the pulp was reserved for the bleaching investigation at the minimum degree of defibering believed desirable for bleaching grade pulps. These points are indicated by footnote *d* in Table III, which records these defibering data. Small amounts of the pulps were subjected to attrition mill passes in excess of that judged necessary for satisfactory bleaching grade pulps. This was done in order to provide pulp samples to serve in the study of the influence of the degree of attrition mill treatment on the permanganate numbers of the pulps.

Bleaching Investigation

A number of 50-gram charges of each N.S.S.C. pulp were chlorinated to various degrees. Following alkaline extraction treatments, each pulp was subjected to the determination of the permanganate number of the alkali-extracted pulp. In addition to the investigations on the mixed hardwood and the aspen N.S.S.C. pulps, similar experiments were carried out on three laboratory-prepared spruce sulphite pulps of widely varying permanganate number and on several hardwood N.S.S.C.–spruce sulphite pulp blends. These data were recorded in Table IV.

It is necessary at this point to describe the procedures employed in this work. Chlorinations were carried out in widemouth jars of capacity of about 4 liters. An acidified bleach liquor technique, described below, was employed in order to simplify the handling and transfer problems of the chlorine. Other work has indicated that this method can be used interchangeably with the method of chlorination using chlorine water.

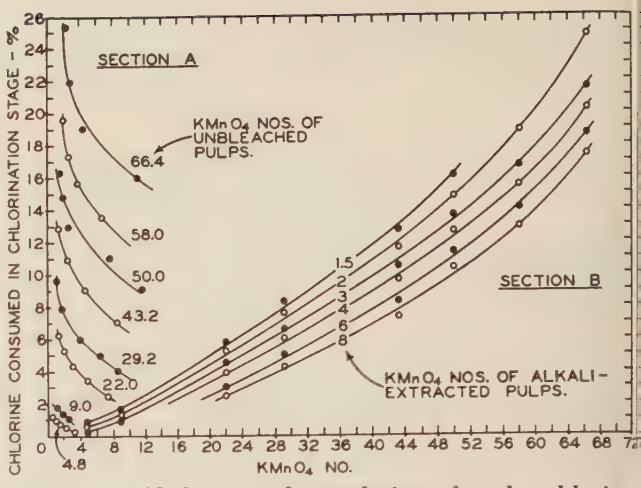

Fig. 1. Establishment of correlations for the chlorination stage

(1). Abscissa in section A—$KMnO_4$ no. of alkali-extracted pulp. (2) Abscissa in section B—$KMnO_4$ no. of unbleached pulp. (3). Points in section B interpolated from section A. (4). Pulps with $KMnO_4$ nos. of 4.8, 9.0 and 22.0—spruce sulphite. (5). Pulps with $KMnO_4$ nos. of 29.2, 43.2, 50.0, 58.0 and 66.4—mixed hardwood N.S.S.C.

Fifty-gram charges (moisture-free basis) were weighed out from the centrifuged stock and dispersed in water. The pulps were then dewatered on a 6-in. Buchner funnel, into the bottom of which was fitted a disk of 100-mesh stainless steel wire cloth. The pulp was retained as a cake until all was in readiness for the chlorination. The measured amount of bleach liquor was added to the predetermined amount of water and completely mixed. Consistencies were adjusted to 3% except in the case of pulps with permanganate numbers 50 or over, in which cases the consistencies were adjusted to 2.5%. Discretion was used in the adjustment of the water temperature so that the reaction temperature was maintained in the range of 20 to 24°C. The pulp cake was broken into a few large portions and dropped into the mixture of water and bleach liquor. An amount of dilute (10%) hydrochloric acid, equivalent to the lime used in the formation of the bleach liquor, was immediately introduced to the container and the cover secured. The manual agitation was begun rather mildly in order to mix the acid into the bulk of the liquid most easily. At the end of 1 hr., the pulps were dewatered on the Buchner funnel. Each pulp was washed with about 1500 ml. of cold water. The pulp cake was then removed from the filter to permit the washing of the remaining pulps of the series.

When all was in readiness to begin the alkaline extractions, the pulp cake was returned to the Buchner

Table II. Details of the Mixed Hardwood and the Aspen N.S.S.C. Cooks

Cook No.	*Wood identification*	*Sodium sulphite based on wood, %*	*Sodium carbonate based on wood, %*	*Liquor–wood ratio*[a]	*Maximum temperature, °C.*	*Time at maximum temperature, hr.*	*Cooking end point, g./liter sodium sulphite*	*Waste liquor pH*	*Crude cooking yield, %*	*Modified permanganate No.*[b]
572	Mixed hardwood	28	0	4.5	175	7	9.1	7.5	56.9	29.2
570	Mixed hardwood	24	1	4.5	175	5	9.5	7.3	61.0	43.2
569	Mixed hardwood	20	2	4.5	170	$5^2/_3$	9.9	7.3	62.6	50.0
568	Mixed hardwood	16	3	4.5	170	3	9.1	7.0	68.8	58.0
567	Mixed hardwood	12	4	4.5	165	2	9.1	6.8	75.8	66.4
573	Aspen	22	0	6.5	175	$4^5/_6$	7.1	7.1	62.3	35.2
571	Aspen	14	4	6.5	165	$2^1/_2$	7.1	7.1	74.4	57.2

[a] Liters liquid, including wood moisture, per kilogram moisture-free wood.
[b] Determined on pulp samples reserved for the bleaching investigation (see Table III).

funnel and the pulp rewashed with about 1500 ml. of water at about 50°C. Caustic soda and water of the proper temperature were measured out and added to the hot pulp cake, previously placed in the jars used for the chlorinations, so that a pulp consistency of 5% and a temperature of 50°C. were obtained. The pulps were mixed initially and once again after the elapse of about 30 min. As is indicated in Table IV, the amount of caustic soda was increased from 3 to 5% for a number of the pulps in the higher permanganate number range. After a retention time of 1 hr. at a sustained temperature of 50°C., the pulps were returned to the Buchner funnel for washing. Washing was carried out with about 1500 ml. of cold water followed by a like amount at about 40°C. The washed cakes were diluted with water to a definite volume (8 liters). Consistency tests on the pulp slurries permitted the notation of the yield of the semi-bleached pulps and indicated the volume of slurry for use in the determination of the permanganate number of the alkali-extracted pulp.

DISCUSSION

Establishment of the Correlations for the Chlorination Stage

The experimental chlorination and alkaline extraction data (Table IV), pertaining to the three spruce sulphite pulps (cooks A, B, and C) and to the five mixed hardwood N.S.S.C. pulps (cooks 567, 568, 569, 570, and 572) were used to prepare correlations for the chlorination stage. In section A of Fig. 1, the chlorine consumption was plotted against the permanganate number of the alkali-extracted pulp for each of these pulps. The chlorine consumptions for the individual pulps that were indicated by interpolation to postcaustic stage permanganate numbers of 1.5, 2, 3, 4, 6, and 8 were correlated with the permanganate numbers of the unbleached pulps (Fig. 1, section B). It was found necessary to impose a number of qualifications upon these correlations. Certain of the factors that were found to limit the generality of the correlations for the chlorination stage were considered in the following section.

Some Qualifications of the Correlations

The data for the aspen N.S.S.C. pulps and for the hardwood N.S.S.C.–spruce sulphite blends were not used as an integral part of the correlation indicated in Fig. 1, but were analyzed by noting the degree of conformity to this correlation. This analysis was conveniently included in Table IV. The figures in parentheses, indicated by the footnote *e*, to which specific attention is called, were interpolated from Fig. 1. The conformity of the experimental data for the hardwood N.S.S.C.–spruce sulphite blends to the correlation of Fig. 1 was quite good. In the case of the aspen N.S.S.C. pulps, the comparison of the permanganate numbers of the alkali-extracted pulps, interpolated from Fig. 1, and the experimentally determined figures for these pulps, revealed that differences attributed to wood species introduced discrepancies with respect to the established correlation. While the chlorination requirements of the aspen N.S.S.C. pulps could be predicted in a general way, conformity was not sufficiently good to permit the staging of the hypochlorite treatment without the determination of the permanganate number of the alkali-extracted pulp. In some pulping investigations involving a number of individual hardwood species and various commercial blends of mixed hardwoods, the deviations, attributed to wood species, were observed to be minor and rarely exceeded the deviations noted in the case of the aspen N.S.S.C. pulps.

In the pulping investigation of some coniferous species, neutral sulphite and a number of other related high-yield methods were employed. When the correlation established in Fig. 1 was applied to these pulps, the correlation was found to break down seriously. The following example was found to be typical of the behavior of these pulps.

A spruce neutral sulphite semichemical pulp with a permanganate number of 54.8 was chlorinated with 14.5% available chlorine. The permanganate number of the alkali-extracted pulp was 7.1 following a "standard" extraction and 5.2 following a "strong" alkaline extraction. These figures were compared with the figure 3.8 which was interpolated from the correlation established in Fig. 1. In the above example, the "standard" extraction was defined as 3% caustic soda at a pulp consistency of 5% at a temperature of 50°C. for 1 hr. (final pH 11.6). The "strong" extraction treatment was defined as 5% caustic soda at a pulp consistency of 10% at a temperature of 73°C. for 1 hr. (final pH 12.1).

The degree of attrition mill treatment was another factor that was found to limit the generality of the correlations for the chlorination stage. The experimental evidence at hand dealing with this question has already been presented in Table III. Examination of these data indicates that in the relatively broad ranges studied, the permanganate number was remarkably independent of the degree of defibering. The deviations appeared to become significant, however, when very

Table III. The Influence of the Degree of Attrition Mill Treatment on the Modified Permanganate Number of the Mixed Hardwood N.S.S.C. Pulps

Cook No.	Crude cooking yield, %	Pass 1,[a] 3% consistency KMnO4 No.[b]	Pass 1,[a] 3% consistency Freeness[c]	Pass 2,[a] 3% consistency KMnO4 No.	Pass 2,[a] 3% consistency Freeness	Pass 3,[a] 6% consistency KMnO4 No.	Pass 3,[a] 6% consistency Freeness	Pass 4,[a] 6% consistency KMnO4 No.	Pass 4,[a] 6% consistency Freeness	Pass 5,[a] 6% consistency KMnO4 No.	Pass 5,[a] 6% consistency Freeness
572	56.9	29.0	725	29.2	665[d]	29.0	540	...	...	...	...
570	61.0	42.8	760	43.2	740[d]	42.8	600	...	...	...	...
569	62.6	49.2	750	49.2	690	50.0	620[d]	49.6	490	49.6	375
568	68.8	56.0	750	56.8	715	58.0	640[d]	58.4	580	58.0	505
567	75.8	63.2	740	64.8	690	66.4	550[d]	67.6	480	...	...

[a] Identification of the cumulative number of passes through the Sprout-Waldron 12-in. laboratory model attrition mill.
[b] Modified permanganate number of the unbleached pulp.
[c] Canadian standard freeness, ml. (converted from Schopper-Riegler freeness by TAPPI Data Sheet 20, final correction dated December, 1945).
[d] Treatment to the main body of pulp, that was reserved for the bleaching investigation, was discontinued at these points.

crudely refined pulps were considered, especially in the case of the rawest mixed hardwood N.S.S.C. pulp, identified by its permanganate number of 66.4 (cook 567). For this reason, the permanganate number, modified as described, may not be suitable for measuring the cooking degree of certain board-type N.S.S.C. pulps without, for example, additional laboratory defibering of the crude pulp. Fortunately, for grades of defibered pulps that might broadly be termed as bleaching grades, the influence of the degree of attrition mill treatment on the permanganate number was found to be minor.

Still another factor that was found to impose qualifications on the correlation was the magnitude of the discontinuity at the points of transition, where the pulp sample weight used in the determination of the permanganate number was either halved or doubled (Table I). One of the mixed hardwood N.S.S.C. pulps (cook 572) had a permanganate number nearly at the transition point of 32. This pulp was tested with both a 0.50 and a 0.25-gram pulp sample. These data were recorded in Table V. The discrepancy between permanganate numbers, determined by the two methods, was about 8%, or what is probably more significant, about 4% from the mean. The discrepancies, introduced at the transition point of 32, were found to be quite definite

Table IV. Results of the Bleaching Investigation

	Chlorination stage, available chlorine, %[a]		Alkaline extraction stage		Alkali-extracted pulp	
	Applied	Consumed	Caustic soda, %[a]	pH final	Modified permanganate No.	Yield[a]
Cook A	0.25	0.25	3	12.0	3.25	.
Spruce sulphite	0.50	0.49	3	12.0	2.3	.
$KMnO_4$ No.[b] 4.8	0.75	0.73	3	12.0	1.6	.
	1.00	0.97	3	11.9	1.05	.
	1.25	1.20	3	11.9	0.6	.
Cook B	1.89	1.80	3	...	1.2	...
Spruce sulphite	1.49	1.42	3	...	1.85	.
$KMnO_4$ No. 9.0	1.08	1.04	3	...	2.65	...
Cook C	2.50	2.43	3	11.9	7.55	.
Spruce sulphite	3.50	3.37	3	11.9	5.1	...
$KMnO_4$ No. 22.0	4.50	4.35	3	11.9	3.1	...
	5.50	5.32	3	11.9	2.0	...
	6.50	6.25	3	11.9	1.45	...
Cook 572	4.0	4.0	3	11.8	8.75	93.9
Mixed hardwood N.S.S.C.	5.0	5.0	3	11.7	6.5	92.5
$KMnO_4$ No. 29.2	6.0	6.0	3	11.7	4.25	92.5
	8.0	7.9	3	11.6	1.75	91.4
	10.0	9.7	3	11.5	1.25	91.2
Cook 570	7.0	7.0	3	11.3	8.65	91.5
Mixed hardwood N.S.S.C.	9.0	9.0	3	10.7	4.6	89.6
$KMnO_4$ No. 43.2	11.0	10.9	3	10.7	2.5	88.3
	13.0	12.9	3	10.8	1.65	88.5
	16.0	14.9	3	10.6	1.55	88.2
Cook 569	9.0	9.0	3	10.4	11.6	88.7
Mixed hardwood N.S.S.C.	11.0	11.0	3	10.4	7.7	87.8
$KMnO_4$ No. 50.0	13.0	12.9	3	9.7	2.45	85.5
	15.0	14.8	3	9.3	2.0	85.0
	17.0	16.2	3	9.6	1.85	85.3
Cook 568	13.5	13.5	5	11.1	6.7	83.0
Mixed hardwood N.S.S.C.	13.5	13.5	3	8.1	7.15	83.0
$KMnO_4$ No. 58.0	15.5	15.5	5	10.6	3.8	82.0
	15.5	15.5	3	7.5	4.9	82.9
	17.5	17.4	5	10.6	2.7	82.0
	17.5	17.4	3	7.5	3.45	82.4
	20.0	19.6	5	10.7	2.15	81.0
	20.0	19.6	3	7.5	2.8	81.0
Cook 567	16.0	16.0	5	10.3	11.3	79.6
Mixed hardwood N.S.S.C.	19.0	19.0	5	10.1	4.5	77.2
$KMnO_4$ No. 66.4	22.0	21.9	5	9.6	2.95	76.8
	26.0	25.3	5	9.9	2.3	76.4
Cook 573	6.0	6.0	3	11.7	6.25 (6.8)[e]	90.5
Aspen N.S.S.C.	7.5	7.5	3	11.7	3.4 (3.9)[e]	89.6
$KMnO_4$ No. 35.2	9.0	9.0	3	11.6	1.4 (2.1)[e]	89.3
Cook 571	13.0	13.0	5	11.5	5.8 (7.4)[e]	83.0
Aspen N.S.S.C.	15.0	15.0	5	11.4	3.9 (4.2)[e]	82.2
$KMnO_4$ No. 57.2	18.0	17.9	5	10.8	1.95 (2.1)[e]	81.6
Blend of spruce sulphite and mixed hardwood N.S.S.C.[c]	2.40	2.34	3	...	6.4 (6.8)[e]	...
	3.40	3.33	3	...	4.5 (4.4)[e]	...
$KMnO_4$ No. 20.4	5.10	4.96	3	...	1.85 (1.6)[e]	...
Blend of spruce sulphite and mixed hardwood N.S.S.C.[d]	4.50	4.43	3	...	5.5 (6.0)[e]	...
	5.10	5.05	3	...	4.4 (5.0)[e]	...
$KMnO_4$ No. 28.1	5.50	5.45	3	...	3.9 (4.0)[e]	...
	6.20	6.13	3	...	3.05 (3.0)[e]	...
	6.20	6.08	3	...	2.8 (3.0)[e]	...
	7.40	7.26	3	...	2.0 (1.7)[e]	...

[a] Based on the unbleached pulp.
[b] Modified permanganate number of the unbleached pulp.
[c] Eighty per cent spruce sulphite.
[d] Fifty per cent spruce sulphite.
[e] Predicted from the correlation established in Fig. 1.

Table V. Extent of Discontinuity in the Modified Permanganate Number at the Transition Point of 32[a]

	Indicated permanganate No. (0.25-gram pulp)	*Modified permanganate No. (0.50-gram pulp)*	*Canadian standard freeness, ml.*
Attrition mill, pass 1	31.2	29.0	725
Attrition mill, pass 2	31.6	29.2	665
Attrition mill, pass 3	31.6	29.0	540

[a] Determined on the mixed hardwood N.S.S.C. pulp from cook 572.

but, fortunately, quite small. Although preliminary data indicated analogous behavior at the other transition points, more study could properly be devoted to this problem. In any event, the deviations encountered were of a magnitude that would interfere with the staging of the hypochlorite treatment if the determination of the permanganate number of the alkali-extracted pulp were not resorted to.

The question of which sample weight is proper when dealing with pulps very near the transition points may require that the test must be repeated with a halved or doubled pulp sample, as the case may require. It is of course possible, for example, for a pulp of permanganate number very near the transition point of 32 to give a permanganate number slightly lower than 32 when using an 0.50-gram pulp sample and slightly higher than 32 when using an 0.25-gram pulp sample. In these cases, if the mean of the two tests is above 32, the figure determined on the 0.25-gram sample is reported. Conversely, if the mean is below 32, the actual figure from the 0.50-gram determination is used. This precedent is extended to the other transition points.

Probably the most obvious factor that may be expected to limit the generality of the correlations for the chlorination stage is the specific set of conditions used in the alkaline extraction stage. A related factor, of course, is the degree of washing, following the chlorination stage. In the establishment of the correlations for the chlorination stage, some rather arbitrary conditions were used. This was necessary because the economics of the use of caustic soda in the alkaline extraction stage, over the entire range of permanganate numbers, was not clear. The correlation for the chlorination stage was established stepwise from the lower end of the permanganate number scale. Three per cent caustic soda based on the unbleached pulp, at a consistency of 5% and at a temperature of 50°C. for a duration of 1 hr., were the specific conditions used for all pulps up to and including the mixed hardwood N.S.S.C. pulp with a modified permanganate number of 50.0. The final pH of the liquors from the alkaline extractions progressively dropped from about 12 at the low end of the permanganate number scale, to about 10 at a permanganate number of 50.0. At this juncture it became apparent that the two remaining mixed hardwood N.S.S.C. pulps with permanganate numbers of 58.0 and 66.4, would probably require more caustic soda if the final extraction pH were to be prevented from falling below 10. The use of caustic soda was arbitrarily increased from 3 to 5% for the pulps with permanganate numbers of 58.0 and 66.4. For purposes of demonstration of the discrepancies introduced when the pH of the alkaline extraction stage was allowed to drop radically, the experiment on the mixed hardwood N.S.S.C. pulp from cook 568 (permanganate number 58.0) was repeated with only 3% caustic soda and the results compared with the data obtained at the level of 5% caustic soda (Table IV, data of cook 568). Relatively minor reductions in the permanganate numbers of the alkali-extracted pulps resulted from the use of the additional 2% caustic soda. This comparison demonstrated the problem of arriving at an economic balance and the danger of unwarranted generalizations. It would be desirable to carry out more experimental work to determine more specifically the effect of the conditions of the alkaline extraction on the correlations for the chlorination stage.

Application of the Correlations to Pulping Investigations

In reference to the correlations presented in Fig. 1, it should be pointed out that the significance of experimental data was brought into better perspective when the correlations were prepared on logarithmic paper. Such plots have always been used for the working diagrams employed in experimental bleaching work. The linear plot of the correlations was resorted to in this publication because of the excessive loss of detail connected with the reproduction on a reduced scale of multiple cycle logarithmic diagrams.

These correlations for the chlorination stage have been applied with discretion in the routine bleaching of pulps, especially those prepared in the course of various high-yield pulping investigations. Experience has indicated that while the correlations are not infallible, many pulping investigations, particularly those involving wide differences in cooking degree, can be expedited by the use of these correlations.

In most investigations it was desirable to treat the pulps as consistently as possible so that differences in pulp properties could be attributed specifically to the pulping variables under study. Although the point may be open to some controversy, a good basis for consistent bleaching would appear to be to reduce the bleach requirement of the pulp, in the first two stages of a three-stage sequence, to a more or less common residual bleach requirement following the alkaline extraction stage. In this case the chlorination usages for the group of related pulps would be determined from one specific curve of constant permanganate number of the alkali-extracted pulp (Fig. 1, section B). Because of considerations already discussed, it has generally been found appropriate to determine the permanganate number of the alkali-extracted pulp for guidance in the addition of hypochlorite in the final stage. The hypochlorite requirement for the final stage of bleaching, unfortunately, is not solely a function of the permanganate number of the alkali-extracted pulp. For example, when a substantial change is made in wood species or in the cooking or bleaching conditions, the empirical determination of a suitably revised correlation is in order. It has been found, however, that remarkable latitude in variables is permissible when hardwood N.S.S.C. and spruce sulphite pulps and blends are considered.

The usual limits of interest in connection with the staging of the hypochlorite treatment are permanganate numbers from 1 to about 8. Wiles (*3*) has presented a table for the approximate conversion of permanganate number to equivalent hypochlorite bleach consumption.

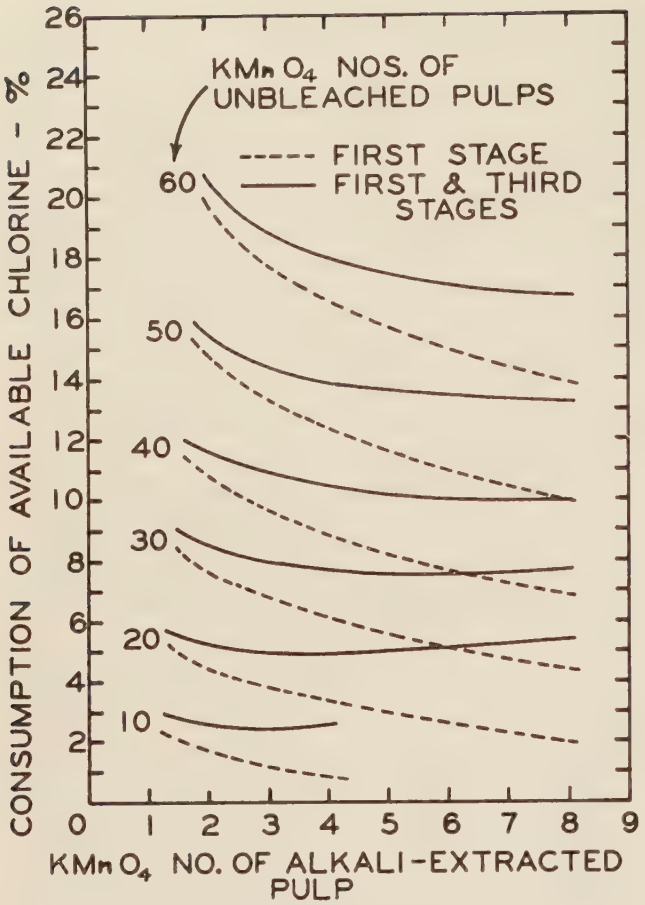
KMn O4 NOS. OF UNBLEACHED PULPS
----- FIRST STAGE
—— FIRST & THIRD STAGES
60
50
40
30
20
10
CONSUMPTION OF AVAILABLE CHLORINE - %
KMn O4 NO. OF ALKALI-EXTRACTED PULP
0 1 2 3 4 5 6 7 8 9
2 4 6 8 10 12 14 16 18 20 22 24 26

Fig. 2. A generalization of the over-all three-stage bleach requirement

This approximate conversion is not necessarily strictly applicable to the modified permanganate number method used in the present work. In any event, the conversion has been used as a basis from which to digress to meet varied requirements. The indicated chlorine requirement for a given post-caustic stage permanganate number, multiplied by either an estimated or a measured yield of the alkali-extracted pulp, places the amount of hypochlorite on the basis of the original unbleached pulp. The hypochlorite requirement, expressed on this basis, can be added directly to the first-stage requirement in order to denote the over-all three-stage bleach requirement.

Generalization of the Over-all Three-Stage Bleach Requirement

The following approximate equation for the hypochlorite stage bleach requirement was employed to facilitate a generalization of the over-all three-stage bleach requirement:

$$\text{Av. Cl} = \frac{(0.355P_3)}{0.8}(1 - 0.003P_1)$$

Av. Cl is the hypochlorite requirement expressed as per cent available chlorine based on the original unbleached pulp. P_1 and P_3 refer to the permanganate numbers of the original unbleached pulp and the alkali-extracted pulp, respectively. While the equation is of sufficient precision for the ensuing purposes, its indiscriminate use is unwarranted.

The first term in the above equation, $0.355P_3/0.8$, is a generalization from the work of Wiles (*3*). The factor 0.8 was taken as an approximation adequately representing the correlation of Wiles in the narrow permanganate number range below 8.

The second term in the above relation, $1 - 0.003P_1$, was intended as a rough correction for purposes of converting the third-stage hypochlorite requirement to the basis of the original unbleached pulp. In order to establish this rough correction, the yields of the semi-bleached pulps, recorded in Table IV, were interpolated to a number of permanganate numbers of the alkali-extracted pulps, and the interpolated yield figures subsequently correlated with the permanganate numbers of the unbleached pulps. The linear approximation of these yield data, defined by the factor $1 - 0.003P_1$, was used because further refinement was believed both unwarranted and unnecessary for the purposes at hand. This approximation does not allow for a slight deviation from linearity, nor does it distinguish the actual permanganate number of the alkali-extracted pulp.

The generalization of the total chlorine requirement was made using interpolated figures from Fig. 1 for the first-stage requirement and the approximate relation discussed above for the third-stage requirement. The over-all generalization was presented in Fig. 2. The major significance of this diagram was the indication that the over-all three-stage bleach requirement of a pulp is dependent upon the permanganate number of the alkali-extracted pulp as well as that of the unbleached pulp. In other words, no perfectly general three-stage bleach requirement can be ascribed to a pulp without taking into account the specific partitioning of chlorine between the first and third stages.

CONCLUSION

Three-stage bleach control methods have been worked out and have proved especially valuable in the experimental bleaching of pulps prepared in the course of various high-yield pulping investigations. These bleach control methods were dependent upon a simple modification of the Wiles permanganate number test. This modification permitted the measurement of permanganate numbers of from 0 to 70 or more.

It has been demonstrated that it was impossible to assign a perfectly general three-stage chlorine requirement to a pulp. In order to circumvent this difficulty, the permanganate number of the alkali-extracted pulp was introduced as a variable, making possible separate correlations for the first and third stages. The use of these correlations permitted a relatively high degree of flexibility and control, important both in experimental and commercial bleaching.

LITERATURE CITED

1. Girdler, H., *Tappi* 36, No. 4: 128A (April, 1953).
2. Trout, P. E., Franckowiak, P. A., Ham, J. L., Browning, B. L., and Bublitz, L. O., *Tappi* 36, No. 3: 123–126 (March, 1953).
3. Wiles, R. H., *Paper Trade J.* 98, No. 11: 34–35 (March 15, 1934).

This paper is an extension of the remarks made by R. H. Rasch, Head of Research Section, Hammermill Paper Co., before the Semichemical Pulping Committee of TAPPI at the Annual Meeting in New York in February, 1953. The suggestions and comments of Mr. Rasch have proved invaluable in the preparation of the present paper.

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Stain Technique for Differentiating Hardwood and Softwood Mechanical Pulps

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In a study of the grinding and screening operations involved in the production of mechanical or groundwood pulps, a rapid and fairly accurate method was required for the differentiation of hardwood and softwood fibers present in the same system. A convenient technique for making this differentiation has been developed by employing the Mäule stain reaction.

THE Mäule reaction was apparently first used in 1900 (*4*) as a qualitative test for lignin. This reaction, as later described by de Lamarlière (*3*), Schorger (*5*), Crocker (*1*), and Sharma (*6*), was found to produce a red color when the test was applied to hardwoods (angiosperms) but only a yellow or brown color resulted when softwoods (gymnosperms) were treated. The test has, therefore, been found of use in distinguishing hardwood and softwood in bulk form.

From the history of the Mäule stain reaction, it was concluded that the test might be applied to the differentiation of hardwood and softwood mechanical pulps. All the major components of the original wood are present in mechanical pulps and the only apparent difference in the stain application to woods in bulk and in pulp form is a matter of physical size of the material to be stained. A number of tests were made to determine the validity of the Mäule stain reaction with reference to groundwood pulps and quantitative fiber counts.

PROCEDURE

The following procedure was used in evaluating the Mäule stain reaction:

1. A microscope slide was prepared with fibers as for the usual fiber analysis (*2*).
2. Five drops of a 1% potassium permanganate solution were applied to the 1 by 1-in. fiber area on the slide and the slide was tilted to spread the solution evenly. The stained area was then allowed to remain in contact with the permanganate for 2 to 3 min.
3. The slide was dipped into distilled water to wash the permanganate from the fiber area. If carefully done, no fibers are removed in this rinsing operation.
4. Two drops of 6 *N* hydrochloric acid were applied to the fiber area and, after a few seconds, the slide was dipped into distilled water to remove the acid.
5. Two drops of ammonium hydroxide solution (1 part concentrated hydroxide to 5 parts distilled water) were applied, followed by a cover glass. The excess liquid was then drained off.
6. A fiber count was made in the customary manner (*2*).

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The pulps used in testing the stain reaction were suspensions containing known amounts of one or more of the following:

A. Unbleached softwood groundwood.
B. Unbleached hardwood groundwood.
C. Peroxide-bleached hardwood groundwood.
D. Hypochlorite-bleached hardwood groundwood.
E. Bleached softwood sulphite.

The histories of these pulps are given in the Appendix.

The consistencies of the individual suspensions of these pulps were determined by filter paper filtration and oven drying and then various pulp slurry combinations were made up by mixing the proper volumes of the respective individual fiber suspensions. The mechanical pulp samples represented grinder pit conditions, excluding only the visually oversized pieces of wood.

When the bleached sulphite pulp was a component of a fiber mixture, the C-stain technique (*2*), in addition to the Mäule stain, was used to obtain a direct measure of the weight factors of the groundwood pulps.

RESULTS AND DISCUSSION

A summary of the results obtained using the procedures described above is given in Tables I and II.

The first point of interest is the fact that the hardwood mechanical pulps used were contaminated to a considerable degree with softwood mechanical pulp. This is not surprising, however, because the respective pulps were obtained from grinders operating on a common white-water system; thus, though the pulp samples derived from grinders utilizing the respective woods, the groundwood white water used in the grinding operation contained predominantly softwood fines that were thereby introduced at the hardwood grinder. On the other hand, the softwood mechanical pulp samples were apparently free of hardwood fines. The contamination of the hardwood mechanical pulp can be estimated, however, as is shown below.

The weight factor for the softwood groundwood can be calculated from the data given in the extreme right-hand columns of Table I. Thus, for any of the two-component fiber systems used, the following relationship holds:

$$b = \frac{BaA}{B(100 - B)} \qquad (1)$$

where

A = actual count of fiber 1, % of total
B = actual count of fiber 2, % of total
a = weight factor for fiber 1
b = weight factor for fiber 2
B = true content of fiber 2, % of total

Because the bleached sulphite appeared to be western hemlock, a is equal to 1.2 (*2*) if the bleached sulphite is

Table I. Data Relating to the Differentiation of Hardwood and Softwood Mechanical Pulps by the Mäule Stain Reaction

Per cent of indicated fiber in mixture "as prepared" and "as determined" (no weight factors used)

Mixtures of hardwood and softwood mechanical pulps: hardwood content					
Trial 1[a]		*Trial 2*[a]		*Trial 3*[a]	
Prep.	*Det.*	*Prep.*	*Det.*	*Prep.*	*Det.*
0	0	0	0	0	0
12	18	10	12	10	7
22	30	20	24	24	26
30	32	30	38	34	40
40	51	40	44	44	44
50	58	50	56	54	64
58	70	60	71	64	60
67	68	70	74	74	65
80	81	80	77	100	92
90	87	90	84	...	
100	92	100	89	...	

Mixtures of bleached sulphite pulp with					
Hardwood mech. pulp: hardwood pulp content			*Softwood mech. pulp: mech. pulp content*		
	Det.			*Det.*	
Prep.	*M*	*C*[b]	*Prep.*	*M*	*C*[b]
(A) 25	24	25	30	...	32
(B) 70	61	72	75	...	71
(C) 100	95	..	100	100	..

Softwood mech. pulp content in above mixtures	
Prep.	*Det.*
(A)	1
(B)	2
(C)	5

[a] Each trial was complete, with fresh grinder samples being taken in each case; the time intervals between these trials were approximately 6 mos.
[b] These counts made with C-stain; all other counts made with Mäule stain.
Note: All determined values are the averages of duplicate-slide counts; all counts made by one operator.

designated as fiber 1 in the bleached sulphite-softwood groundwood mixture. Accordingly, the computed values of b are as follows:

B	A	B	b
30	68	32	1.09
75	29	71	1.47

The large difference between the two calculated values of b is apparently due, in the main, to the effect of the softwood mechanical pulp fines on the fiber counting procedure. Thus, as the fines content of the fiber mixture increased, the groundwood content became underestimated. For the purposes of the present discussion, however, the two values of b can be averaged to give a weight factor of 1.3 for the softwood mechanical pulp.

The value of b for the hardwood mechanical pulp may be determined by reference to the data (C-stain) obtained for the hardwood groundwood-bleached sulphite mixtures. Again, if the bleached sulphite is designated as fiber 1 in the mixture, the computed values of b are as listed below, assuming all the groundwood present is hardwood:

B	A	B	b
25	75	25	1.20
70	28	72	1.09

Thus, the average weight factor for the hardwood mechanical pulp is 1.1 when based on the C-stain counts. The weight factor for the hardwood groundwood is 1.4, however, when based on the data obtained using the Mäule stain reaction (again assuming all the groundwood present is hardwood):

B	A	B	b
25	75	25	1.20
70	37	63	1.64

The C-stain data are considered to be much more reliable because the differentiation between the groundwood and chemical pulps is much clearer using C-stain than when an attempt is made to determine the contaminating softwood mechanical pulp fines by the Mäule stain. Thus, using the Mäule stain, some of the unstained softwood groundwood fines may have been "lost" in the counting procedure thereby underestimating the total groundwood content. The average weight factor of the hardwood groundwood is taken, therefore, as 1.1 indicating a smaller average width than that of the softwood groundwood.

A measure of the contamination of the hardwood mechanical pulp used in the present study can be obtained by examining the four sets of data in Table I corresponding to slides prepared as all hardwood groundwood. Averaging these data, the "prepared" value is 100% and the "determined" value is 92% by the Mäule stain reaction. Rearranging equation (1), the true hardwood content, B, can be obtained:

$$B = \frac{b\mathrm{B} \times 100}{a\mathrm{A} + b\mathrm{B}}$$

The values for substitution in the above relationship are A is 8, B is 92, a is 1.3, and b is 1.1. B is then calculated to be 91%, the actual hardwood content of the prepared hardwood mechanical pulps. The "prepared" and "determined" values given in Table I may now be corrected in view of the known extent of softwood contamination of the hardwood and in view of the respective weight factors computed earlier. The

Table II. Data Relating to the Effect of Bleaching on the Mäule Stain Reaction

Hardwood mechanical pulp bleached as indicated and then stained

Bleaching agent[a]	*Amount applied, % on moisture-free pulp*	*G.E. brightness, %*[a]	*Hardwood content, %*	
			Prep.	*Det.*
None	.....	62.0	100	92
Peroxide	2.0 as Na_2O_2	74.8	100	95
Hypochlorite	10.0 as Cl_2	73.0	100	91
Hypochlorite	10.0 as Cl_2 plus SO_2 to pH 6	75.0	100	96

[a] For bleaching and brightness test procedures, see Appendix.

Table III. Corrected Counts of Hardwood-Softwood Mechanical Pulp Mixtures "As Prepared" and "As Determined" by the Mäule Stain Reaction[a]

Per cent of hardwood fiber in mixture "as prepared" and "as determined"

Trial 1		*Trial 2*		*Trial 3*	
Prep.	*Det.*	*Prep.*	*Det.*	*Prep.*	*Det.*
0	0	0	0	0	0
11	16	9	10	9	6
20	27	18	21	22	23
27	28	27	34	31	36
36	47	36	40	40	40
46	54	46	52	49	60
53	66	55	67	58	56
61	64	64	71	67	61
73	78	73	74	91	91
82	85	82	82	..	..
91	91	91	87	..	..

[a] Uncorrected values given in first six columns of Table I.

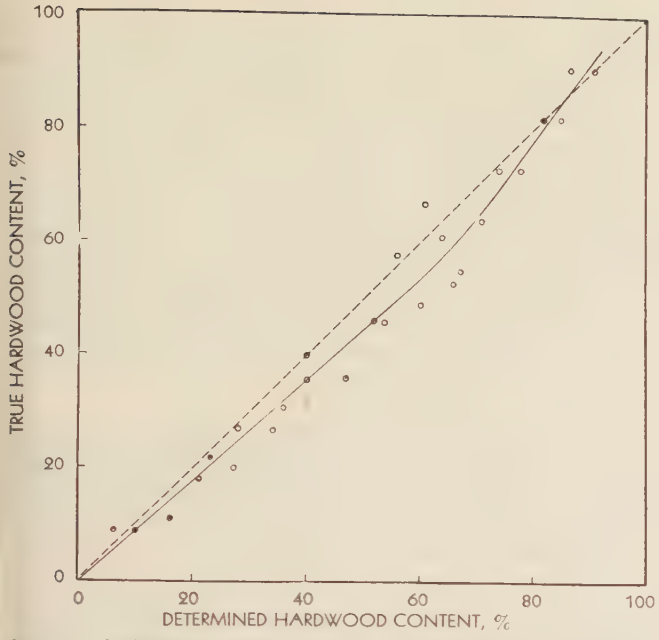

Fig. 1. Relation between true and determined hardwood contents

Corrected values obtained from Mäule stain analyses of hardwood-softwood mechanical pulp mixtures.
Expected: Broken line. Actual: Solid line.

corrected values are given in Table III and are shown in Fig. 1.

An inspection of Fig. 1 reveals that there still remains a systematic error that has been unaccounted for in the preceding discussion. Thus, high hardwood counts may generally be expected in using the Mäule stain technique (with the particular groundwood pulps studied) and the highest errors apparently occur when the true hardwood content is about 50% of the hardwood-softwood mixture. The probable cause for this systematic error would seem to be based on the underestimation of the softwood mechanical pulp fines thereby giving high results for the hardwood component; if the counting procedure actually does overlook the unstained softwood fines, the maximum error in counting would occur when the mixture contains approximately 50% of each type of fiber. In any case, this error may be taken into account by the use of a calibration curve such as shown in Fig. 1. A count accuracy of about ±5% may then be expected and this tolerance is considered satisfactory, in view of the counting difficulties inherent in an all-groundwood slide. It should be emphasized that the calibration given in Fig. 1 applies only to the particular groundwood pulps used in the study.

Examination of Table II shows that the Mäule stain reaction is apparently not influenced by the peroxide, hypochlorite, or sulphur dioxide treatments. Thus, the centers of activity responsible for the Mäule stain reaction of hardwood lignin are not affected by these bleaching processes.

It may also be noted that the Mäule stain gave negative results when applied to unbleached spruce sulphite pulp, to unbleached poplar soda pulp, and to unbleached oak kraft pulp. The negative reactions with the hardwood pulps might have been due to the possible nonreactivity of the modified lignin produced during pulping; it is more probable, however, that the negative reactions were due to the small amount of lignin remaining with the pulps (the respective Klason lignin contents of the two hardwood pulps did not exceed 0.6%).

SUMMARY AND CONCLUSIONS

The application of the Mäule stain reaction for the differentiation of hardwood and softwood mechanical pulps has been evaluated. Mixtures of commercially produced hardwood and softwood groundwoods were treated with the Mäule stain with the observation that, by the use of appropriate weight factors and an empirical correction, either of the components of the mechanical pulp mixture can be estimated within ±5%. Groundwood bleaching by hypochlorite or by peroxide apparently does not affect the Mäule stain reaction.

APPENDIX

The histories of the pulps used in the described study are given below.

Softwood Mechanical Pulp

The softwood mechanical pulp was a mixture containing about 85% black spruce and 15% balsam fir as furnished at the grinder. The pulp was produced on a three-pocket grinder at the nominal Canadian Standard freeness of 100 ml. at the grinder pit. Typical Bauer-McNett fiber classification data for this pulp are as follows:

Mesh size	%
Fiber on 20	6.8
35	15.4
65	16.4
150	21.0
Fiber through 150	40.4

Hardwood Mechanical Pulp

The hardwood mechanical pulp was predominantly poplar. However, at the mill from which these samples were obtained, poplar and spruce woods are ground separately but the two pulps are combined before thickening in the approximate ratio of 30% poplar and 70% spruce. The white water returned to all the grinders contains a preponderance of softwood fines and therefore the hardwood pulp becomes contaminated to a substantial degree.

The hardwood mechanical pulp was produced on a three-pocket grinder at the nominal Canadian Standard freeness of 150 ml. at the grinder pit. Typical Bauer-McNett fiber classification data for this pulp are as follows:

Mesh size	%
Fiber on 20	2.3
35	9.6
65	21.7
150	22.6
Fiber through 150	43.8

Peroxide-Bleached Hardwood Mechanical Pulp

A sample of freshly ground hardwood mechanical pulp (produced as described above) was obtained from a decker at 7.7% moisture-free consistency and a Canadian Standard freeness of 145 ml. Peroxide bleaching was carried out by adding 2.0% peroxide ($^1/_2$ sodium peroxide and $^1/_2$ hydrogen peroxide computed as sodium peroxide), 5.0% sodium silicate (42° Bé.), and a small

amount of Epsom salt to 150 grams moisture-free pulp at 5% moisture-free consistency. The initial bleaching pH was 10.5 and the temperature was maintained at 120°F. during the reaction. After 8 hr. (peroxide not exhausted), the pulp mass was gassed with sulphur dioxide to pH 5.3.

At the end of the bleaching treatment, the equivalent of 4.0 grams moisture-free pulp was sampled and this was diluted to 1 liter with distilled water. The pulp slurry was thoroughly mixed and then filtered through a filter paper in a Buchner funnel. The pulp pad was stripped from the filter paper, redispersed in 1 liter of distilled water, and two brightness pads were formed by filtration through fresh filter papers in the Buchner funnel, each from 500 ml. of the pulp slurry. The resulting pads were pressed between clean dry blotters at 100 p.s.i. for 1 min. and then were allowed to air dry between clean dry blotters. Brightness readings were made on the pads within 24 hr. after forming. The same procedure was also followed in making brightness pads of the unbleached pulp.

Hypochlorite-Bleached Hardwood Mechanical Pulp

A 150-gram moisture-free equivalent sample of the unbleached groundwood (as used above for peroxide bleaching) was measured out and diluted to 5% moisture-free consistency with distilled water and sodium hypochlorite bleach liquor to give 10.0% available chlorine on the weight of moisture-free pulp. The initial bleaching pH of 11.7 was obtained by adjustment with 1.25% sodium hydroxide based on the moisture-free pulp. The final pH of 9.0 was reached in 1.5 hr. at exhaustion of the hypochlorite. The bleaching temperature was 90°F. At exhaustion of the available chlorine, a sample of the pulp was removed for brightness determination and the remainder of the pulp was gassed with sulphur dioxide to pH 6.0, after which another sample was taken. The pulp pads for brightness determination were prepared as described in the previous section.

Bleached Softwood Sulphite Pulp

The bleached softwood sulphite pulp was obtained in dry lap form from a West Coast pulp mill. By microscopic analysis, the pulp appeared to be predominantly western hemlock.

LITERATURE CITED

1. Crocker, E. C., *Ind. Eng. Chem.* 13: 625 (1921).
2. Graff, J. H., "Pulp and Paper Microscopy," 2nd ed., Appleton, Wis., The Institute of Paper Chemistry, 1942, especially pages 60–62 and 112–114.
3. Lamarlière, L. G. de, *Rev. gen. botan.* 15: 149 (1903).
4. Mäule, C., *Beitr. wiss. Botanik* 4: 166 (1900).
5. Schorger, A. W., *Ind. Eng. Chem.* 9: 556 (1917).
6. Sharma, P. D., *J. Forestry* 20: 476 (1922).

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Printing Studies at the Swedish Graphic Arts Research Laboratory—Stockholm, Sweden

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For studying the printability of paper, investigations of ink transfer between surfaces of the same or different kind have been done at the Graphic Arts Research Laboratory in Sweden. The investigations have shown that an increased printing pressure increases the ink transfer and an increased printing speed and ink viscosity decrease the ink transfer. Other variables influencing the ink transfer are the amount of ink on the printing surface, the roughness and the elasticity of the printed surface, and the diameter of the printing cylinders. The results are of importance for paper testing and for the developing of better printing papers.

The Graphic Arts Research Laboratory (*1*) was founded and is supported by the Swedish graphic arts industry, and no contribution is obtained from the government. It is a central laboratory for the whole industry and each firm connected to the laboratory contributes an amount in proportion to the number of employees. The laboratory is situated in the Swedish Forest Products Research Institute and is one of its departments. In the institute there are also departments for paper technology, pulp-making, and there are central laboratories for the pulp and paper industry. By close cooperation with the paper laboratories and others, the graphic arts laboratory has been in a good position to work on problems concerning paper and printing.

At the moment of printing a thin ink film is transferred to the paper. The quality of the print depends on how the ink film is transferred from the printing surface. From the papermaker's point of view it is of interest to know how the paper influences the splitting of the ink film. The properties of the paper itself, however, are not the only important factors in obtaining a good print. There are a lot of other variables such as pressmen, printing presses, inks, etc.

Therefore, if it is desired to define the printability of paper many other factors influencing the printing result must be discussed. That is the reason why it is so difficult to define which properties of the paper are essential for obtaining a good print. It is easier to study the ink receptivity properties of the paper under specific printing conditions. From these studies figures of the ink receptivity are obtained which can be compared with actual printing results. At the same time it is necessary to study how different variables influence the ink transfer (*2, 3, 4, 5*). In the laboratory studies have

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Table I

η	No.	V_1 G_1	V_1 G_2	V_1 G_3	V_1 G_4	V_2 G_1	V_2 G_2	V_2 G_3	V_2 G_4	V_3 G_1	V_3 G_2	V_3 G_3	V_3 G_4
η_1	1	0.97	0.97	0.97	0.97	0.86	0.95	0.96	0.96	0.81	0.86	0.85	0.52
	2	0.90	0.97	0.98	0.98	0.90	0.95	0.93	0.96	0.80	0.85	0.85	0.83
η_2	1	0.87	0.94	0.96	0.97	0.78	0.87	0.86	0.86	0.61	0.73	0.69	0.65
	2	0.87	0.95	0.96	0.95	0.77	0.88	0.86	0.84	0.65	0.71	0.68	0.61
η_3	1	0.87	0.88	0.93	0.86	0.58	0.75	0.77	0.75	0.53	0.59	0.55	0.50
	2	0.86	0.90	0.94	0.90	0.65	0.79	0.78	0.75	0.57	0.64	0.58	0.50

Ink: mineral oil.
(G) Amount of ink, gram/sq. m.: $G_1 = 1.80$; $G_2 = 5.20$; $G_3 = 8.50$; $G_4 = 11.80$.
(η) Ink viscosity, poises: $\eta_1 = 68.7$; $\eta_2 = 168$; $\eta_3 = 321$.
Surfaces: smooth steel to smooth steel.
Transfer: cylinder to cylinder.
Total pressure: constant (3.7 kg. on 2 in.).
Printing speed: cm./sec.: $V_1 = 9.5$; $V_2 = 19.0$; $V_3 = 37.5$.

been concentrated on what happens when an ink film is transferred from one surface to another.

Let us assume that we have a surface with an ink film on it and another surface is pressed against it. Some of the ink is transferred from the first surface to the other. If the surfaces have the same smoothness, the ink film will probably split in the middle if the time of contact is long enough. But, if the same experiment is repeated and the ink touched suddenly, it will be found that the film has not split in the middle. More ink remains on the originally inked surface. In order to record how an ink film is divided between two surfaces, an ink transfer number (Y) has been defined. This number is the ratio of the ink transferred to the printed surface to the ink left on the printing surface which is illustrated in Fig. 1. This ratio is a very sensitive value of ink transfer and can be used as an absolute figure of ink receptivity. It can also be studied as a function of other different variables, such as time of contact, printing pressure, viscosity of the ink, amount of ink on the printing surface, paper quality, etc. The background of the choice of this ratio instead of only the amount of ink transferred is the following. If there is an ink film on a printing surface, such as a halftone block, some of the ink is transferred to the paper at each impression. If there is much ink left on the block after the moment of printing, there will be an increased amount of ink on the block the next time the inking roller passes over it. This causes a filling up of the screen and it will be difficult to get a clean print from the form. If more ink is needed on the block to get a black print, the risks for filling up will increase. From the ratio of ink transferred and left, and the amount of ink used for making an impression on the paper, there are sufficient data to describe what happens. In order to get a good print it is essential to use the minimum amount of ink to obtain the desired density and to transfer the ink to the printed surface in a suitable way.

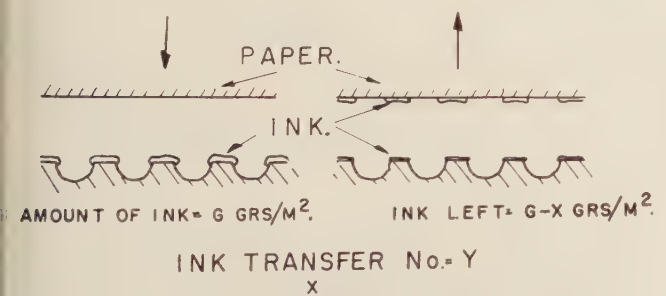

Fig. 1. An illustration of the ink transfer number. (Y)

In the first studies of ink transfer a no. 4T Vandercook proof press and an automatic letterpress printing press were used. However, it was very difficult to control the variables on this equipment for fundamental physical studies. Therefore a special laboratory instrument was designed for this purpose. The instrument designed is very much like a simplified printing press as can be seen from Fig. 2.

The instrument consists of two small cylinders, the lower one being fixed in the frame. The upper cylinder is counterbalanced by a fixed weight, and the contact pressure between the cylinders is controlled by a variable load. Both cylinders are driven at the same controlled speed by an electric motor. On the surfaces of the cylinders different samples can be held by two clamps. A thin sheet of steel was used as a printing surface on which was applied a known ink film with the aid of a Vandercook press. The caliper of the steel sheet was 0.002 in. The amount of ink on the steel sheet was controlled by weighing the sheet before and after printing.

The first investigations were directed toward studying what happens when an ink film is transferred from one inked surface to another one of the same kind without any ink. We also were interested in how different variables such as printing pressure, viscosity of the ink, amount of ink, and printing speed influence the ink transfer. Some results from such an investigation are shown in Table I. The surfaces investigated were smooth steel.

All experiments are set up and interpreted by statistical methods (analysis of variances). The table of variances is shown in Table II.

As can be seen from Table II, the printing speed interacts both with the ink viscosity and the amount of ink on the printing surface. That proves that the value of the printing speed is very important for the ink transfer to a smooth surface. The existence of these interactions may explain what happens when a layer of ink is transferred from one surface to another. At the same time this experiment shows the high significance of the main variables. As a note, it should be explained here, that if the same experiment is repeated and ink transferred from a steel surface to paper, it will be found that the interactions will not show up in the calculations. The experimental error will increase too much because the paper is irregular, porous, and compressible. The interactions are probably there because they can be shown when printing cellophane and glassine, which have very smooth surfaces.

From this and other experiments, it was possible to verify that the different variables influence the ink

Table II

Source of variance	*Degrees of freedom*	*Sums of squares*	*Mean squares*
η	2	0.3554	0.1777
V	2	0.8070	0.4035
G	3	0.0669	0.0223
$\eta \times V$	4	0.0643	0.0161
$\eta \times G$	6	0.0060	0.0010
$V \times G$	6	0.0507	0.0085
$\eta \times V \times G$	12	0.0170	0 0014
Residual	36	0.0612	0.0017
Total	71	1.4285	

transfer in the following way. An increased printing pressure increases the ink transfer, and increased printing speed and ink viscosity decrease the ink transfer. An increased amount of ink on the printing surface increases the ink transfer, but the influence depends on the amount of ink.

In order to wet a surface rapidly with an ink or a liquid, it is important that the surface shows adhesion to the liquid, and that the speed of wetting is high. For good wetting, the intimacy of contact is also important. This is influenced by the printing pressure, amount of ink, ink viscosity, and printing speed. The ink has to wet and fill up all the cavities of the surface.

It is, however, difficult to prove this hypothesis by experiments, as there are so many variables involved. For instance, oils of the same viscosity but with different surface tension have been tried and it was found that the ink transfer changes. It has not been proved, however, that this is caused by the surface tension itself. It might also be caused by a changing of the viscosity during the printing process. In order to get different surface tensions, silicones which have a tendency to lend thixotropic properties to the oils were used. There are, however, many indications that the surface activity itself may change the ink transfer. It has been possible, for instance, to change the ink transfer from offset blankets and rollers by applying very thin coatings.

According to the geometry of the mechanical system, different results are obtained if the ink is transferred

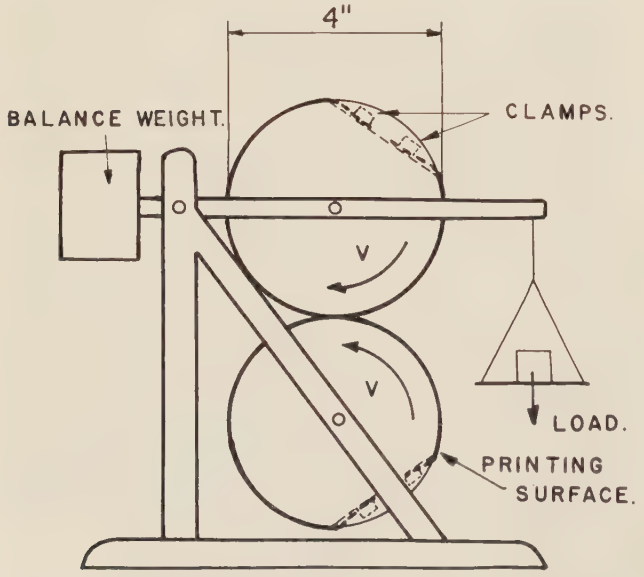

Fig. 2. The principle of the laboratory printing press

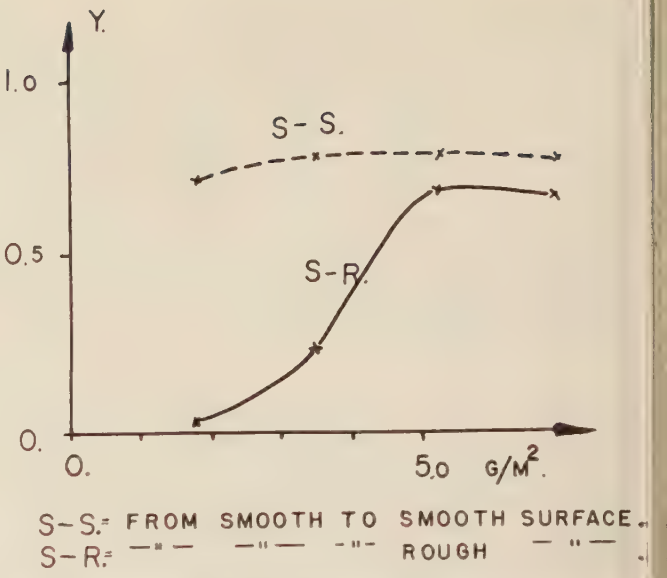

Fig. 3. The ink transfer numbers for surfaces of different smoothness at different amounts of ink on the printing surface

from the surface of one cylinder to another, as compared to transfer from a cylinder to a flat surface and vice versa.

A comparison of the differences in ink transfer between these systems is shown in Table III.

The figures show the sum of the ink transfer numbers for 10 determinations. As can be seen, it is more favorable to transfer ink from one cylinder to a flat surface for both Newtonian and non-Newtonian liquids. In other words, better ink transfer is obtained when going from a smaller cylinder to a larger one.

In order to study how the ink transfer also depends on the roughness of the surface, some steel surfaces were sand-blasted and the effect of smoothness of the surface and different printing variables as they influence the ink transfer were investigated. It was found that a rougher surface does not show the same ink receptivity as a smooth surface for the same amount of ink on the printing surface. This is due to the fact that contact is not as intimate as for smooth surfaces. Some results are shown in Fig. 3. In this experiment, the amount of ink was kept between 0 and 7 grams per sq. m. and the printing speed was kept constant at 37.5 cm. per sec. As ink, mineral oil, 168 poises, was used and the load was 7.4 kg. on a total cylinder length of 2 in.

But when paper is printed upon, a material that has properties quite different from a sheet of steel is being used. The paper is compressible, porous, and shows different degrees of smoothness.

When the smoothness of a certain paper using various instruments is tested different values are obtained. The cause of this variation lies in the way of handling

Table III. Ink Transfer Between Smooth Steel

	⊗↑	⊗↓	⊗⇵
Oil	5.88	7.02	5.52
Ink	7.38	7.42	7.11

Ink = 127 poises (100 r.p.m.).
Oil = 320 poises.
Amount of ink or oil = 3.65 grams/sq. m.
Printing speed = 38 cm./sec.

Table IV

	Cellophane				Glassine				Supercalendered paper			
	P_1		P_2		P_1		P_2		P_1		P_2	
	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
Ink	0.57	0.40	0.83	0.69	0.66	0.52	0.85	0.77	0.83	0.51	1.19	0.95
	0.53	0.38	0.87	0.67	0.64	0.45	0.90	0.68	0.99	0.53	0.20	0.77
Oil	0.66	0.48	0.84	0.74	0.75	0.55	0.90	0.81	1.05	0.69	1.55	0.94
	0.65	0.47	0.86	0.76	0.77	0.55	0.88	0.80	1.07	0.71	1.43	1.01

Printing pressure, P_1 and P_2; amount of ink, 4 grams/sq. m.
Viscosity of oil = 69.5 poises.
Viscosity of ink = 72 poises (100 r.p.m.).
Printing speed, V_1 = 120 cm./sec.; V_2 = 310 cm./sec.

he testing instruments, the pressure between the paper and the testing head, and in the compressibility of the paper. There is a dynamical phenomenon in printing, and the time of ink transfer is very short. In order to get a good transfer of ink, the paper and the printing surface must be brought into intimate contact. The contact depends on the smoothness of the paper under impact. For good contact, the paper must show such visco-elastic properties that all points of the paper surface are in contact with the printing element. Bad sheet forming and rough structure of the paper surface do not give good contact. To get an impression, it is necessary to increase the amount of ink on the printing element or increase printing pressure, but the result will often be a poor impression (filling up, squeezing out, etc.).

From earlier investigations it must be assumed that the laws valid for printing nonabsorbent surfaces are also valid for printing paper. As the paper is porous, the ink transfer will, however, be more dependent on the pressure and the viscosity of the ink and the printing speed. The ink will probably be pressed into the cavities of the surface according to the law of Poisseuille. To illustrate the influence of the printing pressure the difference in ink transfer is shown in Table IV. In this table are shown the values obtained for cellophane, glassine, and supercalendered paper. The porosity of the two first papers is very low. The smoothness of the three papers is about the same.

Different investigations made at the laboratory have also confirmed that the influence of the different variables are the same for nonabsorbent and absorbent surfaces, but the magnitude of the influence is different.

As the printing conditions influence the ink transfer the testing of paper must be carefully controlled. All variables must be kept at fixed values. Different papers, however, need different amounts of ink. Newsprint, for instance, needs more ink than coated paper. For these reasons it is not possible to test all papers with the same amount of ink. A suitable amount of ink for each kind of paper must be determined.

The printing speed is greatly dependent on the press and the strength of the paper. When a paper is tested for ink-receptivity the conditions that prevail in the press should be duplicated to obtain the same influences from the different variables. The importance of the choice of the variables for the ink transfer can be shown in Fig. 4 where ink transfer numbers for newsprint were studied for different printing speeds and ink viscosities. It must be observed that all the points shown in the diagrams represent mean values of several determinations. The points in Fig. 4, for instance, represent nine independent determinations.

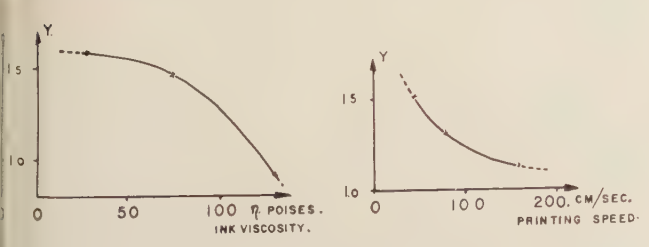

Fig. 4. The influence of the viscosity of the ink and the printing speed on the ink transfer for newsprint

These graphs show that newsprint must be tested at a printing speed of about 2 to 3 m. per sec. or above and a low ink viscosity must be used to obtain values that do not vary too much from one print to another. The same kind of results can be shown for all kinds of papers.

In the laboratory the instrument earlier described is used and paper samples printed at different conditions to determine the ink transfer numbers. A good correlation has been found between these figures and actual printing results. The method used is very sensitive and valuable for paper evaluations. For routine tests it is possible to use conventional printing tests on a proof press, if all variables are controlled. It has been found that it is suitable to use a solid block and print with nondrying black inks. The blackness of the print

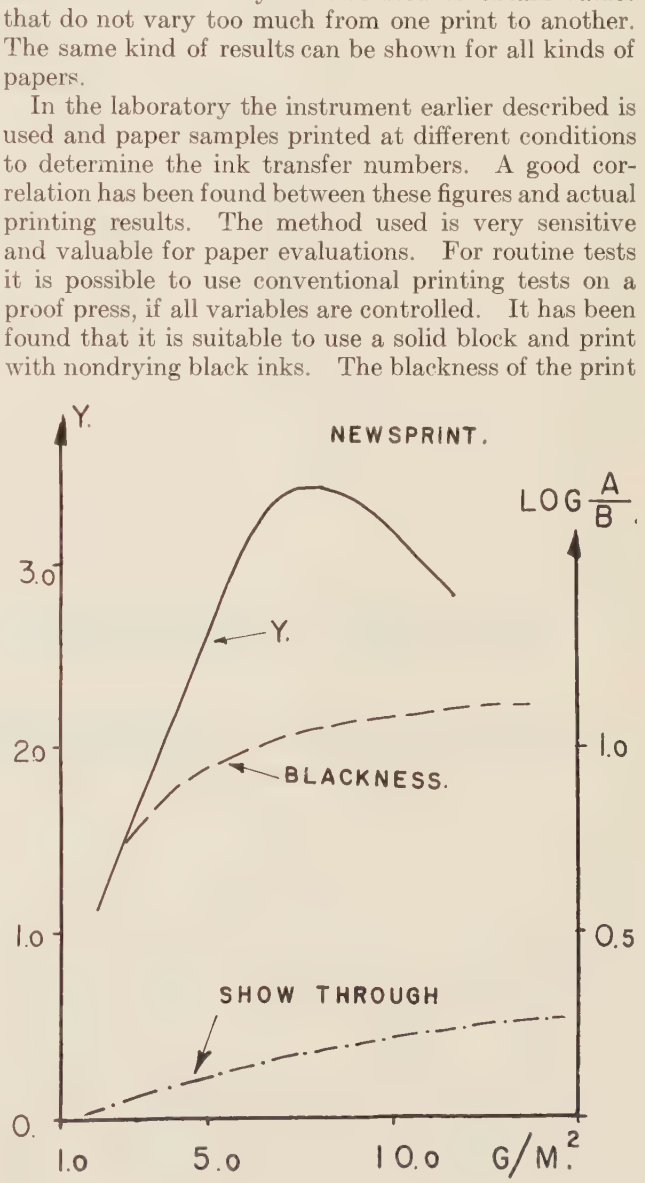

Fig. 5. Ink transfer number and reflection density plotted against amounts of ink on the printing surface for newsprint. The blackness is calculated as the logarithm of the reflectance value on printed and nonprinted paper

can be used as an indicator of ink receptivity of the paper. A second print from the block is valuable to show how much ink is left on the block after the first impression. This test can give an indication of the ink splitting. There is, however, a disadvantage in measuring the amount of ink by reflection, because the blackness value of the print varies very little with the amount of ink on the surface at the ink saturation point, that is, when all the cavities of the paper surface are covered with ink. This can be illustrated by comparing the ink transfer curve and the reflection curve for different amounts of ink on the printing surface. As can be seen from Fig. 5, the reflection values change very little with different amounts of ink on the form, but the ink transfer curve shows a high sensitivity and forms a maximum.

It is often said that the paper absorbs the ink at the moment of printing, but from studies of oil penetration into paper it has been found that this process is very slow and at high printing speed it is of less importance as the ink is pressed into the sheet. The ink-absorbent properties are, however, important for ink setting and ink drying. That the ink is pressed into the sheet in different ways for different kinds of paper can be shown by microscopic examination of cross sections of printed sheets. On supercalendered papers, the vehicle and pigment are pressed into the surface together and the penetration of the vehicle into the sheet is not far from the pigment. On coated paper, the pigment, however, stays on the surface and the vehicle penetrates further into the sheet away from the pigment. Oil penetration tests give valuable information of how fast the vehicle penetrates the sheet, and a fast penetration often results in good ink setting. The speed of ink setting is, however, also dependent on the pigment content of the ink, the viscosity of the vehicle, and how much ink there is on the paper surface. Testing of oil penetration and the amount of ink the paper requires for printing can give information of such effects as offset in the press and ink drying.

It is not possible to discuss the whole subject of paper testing in a short paper. The authors have only given some of the results from investigations of ink transfer. However, there is also of interest how other properties such as sizing of the paper, influence the printing properties. That is both for offset papers and coated papers. For beater-sized paper it has been found that the ink receptivity often increases with increased sizing. For coated paper an increased amount of glue in the coating decreases the ink receptivity and so on.

The surface strength of paper is another important subject and what happens when the paper surface is split up has been studied (*6*). It was possible to develop a simple method for surface strength testing by using an ordinary tensile strength tester. From these tests very interesting information about the strength in different directions of the sheet at different stresses was obtained. There are many other problems connected to the behavior of paper in printing but they cannot be discussed in this paper. It is hoped, however, that some of these results described will give a picture of the kind of work being done and the results obtained at the Swedish Graphic Arts Laboratory.

LITERATURE CITED

1. Carlsson, G., *International Bull.* No. 61: 10 (July, 1952).
2. Pihl, L., *Svensk Papperstidn.* 55: 358 (1952).
3. Olsson, I., and Pihl, L., *Svensk Papperstidn.* 55: 421 (1952).
4. Olsson, I., and Pihl., *Svensk Papperstidn.* 56: 197 (1953).
5. Olsson, I., and Pihl, L., *Svensk Papperstidn.* 55: 233 (1952).
6. Arnamo, A., Olsson, I., and Pihl, L., *Svensk Papperstidn.* 55: 709 (1952).

Received May 20, 1953 Presented at the 38th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 16–19, 1953.

Operating Comparison of Standard and Valveless Deckers on Screened, Bleachable Pine Kraft Pulp

THOMAS L. GILLES and MALCOLM B. PINEO

Data and descriptions are given to show the operating characteristics of a valveless and a standard vacuum filter. The machines are approximately equal in capacity. However, the valveless decker has advantages of lower initial and operating costs and greater ease of operation.

This report is offered as a comparison of two types of suction pulp thickeners operating on the same pulp, under similar conditions at the Brunswick Pulp & Paper Co., Brunswick, Ga. The comparisons will be made on the basis of cost, maintenance, capacity, effluent quality, and other operating characteristics. The word "decker" has been slightly corrupted and is used to mean rotary-type pulp thickener or filter as is common throughout much of the industry.

Thomas L. Gilles, Process Engineer, and Malcolm B. Pineo, Technical Director, Brunswick Pulp & Paper Co., Brunswick, Ga.

REQUIREMENTS OF A DECKER

When choosing a machine for a pulp thickening operation, certain requirements must be met while other qualities can be compromised. The most important requirement is capacity. This means pulp capacity, water removal capacity, and the capacity to operate under the conditions as they exist or as these conditions can be easily altered. The vat and discharge consistencies are among the controlling conditions. Low initial

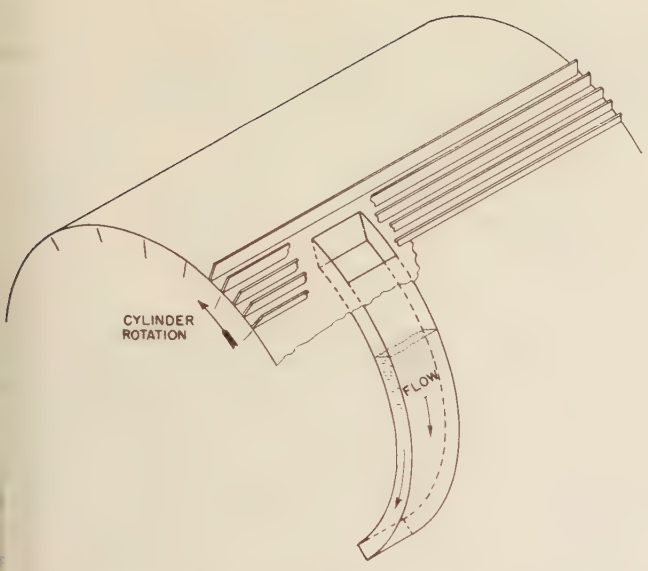

Fig. 1. Diagram of built-in barometric leg on valveless vacuum filter

and installation costs comprise the second requirement. Cost has been placed in second position because it is simply the consequence of obtaining the machine with the necessary capacity. Low installation cost is an important advantage of the valveless decker. The physical size of a machine is another limiting factor. It contributes to installation cost and may even exclude machines that cannot be fitted into existing space.

Operating cost is a complex consideration composed of many other factors including maintenance and down time, power requirements, fiber loss, and operational ease. A durable, simple machine will require less down time and can be easily repaired. Operational ease contributes to low operating costs by indirect means.

DESCRIPTION OF INSTALLATIONS STUDIED

Both machines were manufactured by the Improved Paper Machinery Co., and are located in the screen room. They thicken the screened stock and discharge to a chest from where the pulp is pumped to the bleach plant's brown stock storage. The vacuum decker is on a platform elevated 10 ft. above the screen room operating floor and directly over the screened stock chest. It is raised to permit the use of an adequate drop for the water leg. It occupies about 300 sq. ft. of floor space. Two vertical centrifugal pumps supply stock to either side of the headbox. These pumps are each rated at 5000 g.p.m. and are driven by 50-hp. motors. The vacuum decker has an 8 by 12-ft. cylinder covered with 17 by 24-mesh 316 stainless steel face wire, giving a filtering area of 300 sq. ft. The valve is an external type, having a cone shaped arrangement common in the industry. The headbox is constructed of steel and has an adjustable overflow gate on one side. The discharge mechanism is a double-roll take-off and the pulp is discharged through a chute into a chest below. The barometric leg is 19 ft. long and normally maintains a vacuum of $5^1/_2$ in. The cylinder and take-off rolls are driven by a 10-hp. induction motor.

The valveless decker is set on the operating floor level and, like the vacuum unit, occupies about 300 sq. ft. of floor space. It has no water leg or vacuum pump. It is supplied by a single, 10,000-g.p.m. double suction centrifugal pump driven by a 75-hp. motor. The supply line enters one side of the headbox with the overflow at the opposite side. The decker has a $6^1/_2$ by 14-ft. cylinder covered with 40-mesh, 304 stainless steel face wire giving an area of 284 sq. ft. It is driven by a 15-hp. d.c. motor, powered by a M.G. set. Thus, the cylinder speed can be adjusted. The headbox is of steel construction with the overflow level fixed permanently. The distribution of stock across the cylinder face is controlled by means of a perforated steel baffle plate in the headbox. The uniformity of stock distribution is good.

The vacuum filter and valveless filters are quite similar in outer appearances. It is within the cylinder of the valveless filter that the difference exists. One end of the filter is blanked off and the other is open to discharge the filtrate. The discharge end is equipped with a deckle strap. Under the face and winding wires are longitudinal partitions dividing the outer shell into eighteen compartments or cells. Each of these cells discharges to a duct which follows the curvature of the inside of the cylinder through one third of the cylinder's circumference. There are six banks of these ducts across the cylinder. The back end of each duct discharges to the inside of the cylinder. Following a cell through a cycle will help to illustrate the operation. As a cell and its accompanying duct enter the pulp slurry at the discharge end of the vat, water enters through the cell and into the duct due to the pressure exerted by the difference in levels of the vat and the cell. Water continues to enter the cell and duct under this pressure as the cylinder revolves until the cell is raised above the level of the filtrate within the cylinder. Here, the duct begins to act as a barometric leg with its discharge end sealed in the filtrate. As the cell continues to be raised out of the vat, the suction increases because the barometric leg is becoming longer until, it is reported, a maximum vacuum of $3^1/_2$ in. is attained. At this point the discharge end of the duct is withdrawn from the filtrate, the seal is broken, and the water empties from the duct. The pulp sheet is then ready to be removed by the take-off mechanism and the cycle can begin again.

DATA AND RESULTS

Both of these machines are operating on the same type of pulp. This pulp is a bleachable grade of sulphate southern pine. It has been cooked to a permanganate number of 18 plus or minus 2. It is a very free, long fibered pulp with about 60% of it being re-

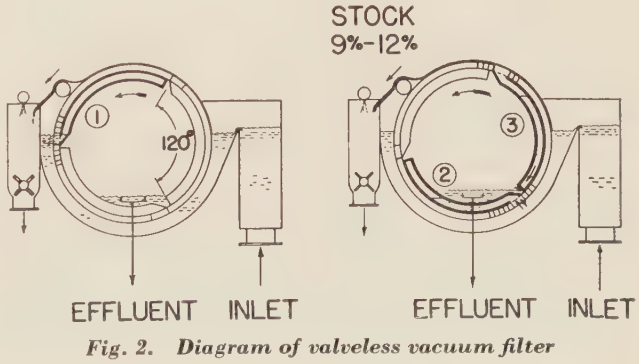

Fig. 2. Diagram of valveless vacuum filter

Table I. Summary of Results

	Vacuum decker			Valveless decker		
	Max.	*Min.*	*Av.*	*Max.*	*Min.*	*Av.*
Vat consistency, %	0.67	0.40	0.48	0.63	0.41	0.50
Discharge consistency, %	13.4	8.8	10.1	10.8	8.7	10.0
Pulp rate, moisture-free tons/day	251	120	197	243	143	194
Water rate, g.p.m.	9200	3430	6340	8750	2790	6760
Cylinder speed, r.p.m.	...	...	3.4	6.6	5.7	6.2
Effluent solids, lb./M gal.	0.25	0.12	0.18	0.27	0.05	0.15
Specific loading, tons/sq. ft./day	0.84	0.40	0.66	0.86	0.50	0.68
Water capacity, gal./sq. ft./min.	3.1	1.1	2.1	3.1	1.5	2.4

tained on a 14-mesh screen. This pulp has been washed to the equivalent of about 5 lb. of salt cake per ton. Kerosene is used in the screen room as a defoamer. The screen room make-up water is obtained from artesian wells which holds the temperature in the decker headboxes within 75 to 80°F. The method used for measuring the pulp and water rates of the deckers was simplicity itself. It consisted of weighing a measured size pulp sample taken from the web at discharge. This together with the discharge and vat consistencies and the cylinder speed enables one to calculate the pulp and water removal rates. The effluent solids were determined by filtering a measured volume of the effluent mixed with a suitable quantity of filter aid for more rapid filtration. The solids were dried and their amount computed.

The results obtained are shown in Table I.

DISCUSSION OF RESULTS

These data are not voluminous nor have they been collected over a long period of time, but it is believed that they represent a fair operating comparison of the two machines. It should be emphasized that this is an operating comparison and that the quantities were measured as they existed under normal conditions. No attempt was made to alter these conditions to determine optimum points as experience had indicated that these points had already been established. The vat consistency of the valveless decker is as a rule, slightly higher than the consistency to the vacuum decker. This is due to a peculiarity in the screen room as they both draw stock from the same chest. This difference is slight but still measurable.

It would seem quite unusual to find a valveless decker discharging at the same or a slightly higher consistency than a vacuum machine. This is the case at Brunswick. The two most important reasons for this are the relatively short barometric leg and the poor condition of the wire on the vacuum machine. This filter has a tendency to seal over when the mill is running short-fibered gum pulp and to remain slighly sealed from this during a pine run. This slight sealing also gives a quite uneven sheet across the vacuum machine and has probably cut down its capacity. The discharge consistency on both machines could be raised 2 to 3% by the use of press rolls.

A comparison of the average capacities of the two units is approximately the same, being expressed as gallons, etc. per unit wire area. The valveless machine cylinder runs much faster than the cylinder on the vacuum machine and is equipped with speed control to give uniformity of operation during rate changes. The vacuum filter is handicapped by this mechanical disadvantage but not seriously.

The effluent solids are low for both machines. This is to be expected for long-fibered chemical pulps. Observation of these solids leads to the conclusion that only a small portion of them are fibers unchanged in their physical dimensions. Most of the effluent solids are micellar or broken fibers together with fine dirt and bark.

The valveless machine is an operator's dream. It very rarely seals or has difficulty picking up or holding the pulp sheet. This is not true of the vacuum job. The operators must give considerable attention to the unit to effect satisfactory operation. The double take-off rolls on the vacuum filter coupled with its uneven sheet and fairly low discharge consistency tend to form a roll of pulp that may reach a diameter of 12 in. and stretch across the machine before it is discharged. This discharge in slugs could give trouble to a machine feeding into a repulper or screw conveyor.

The actual discharge consistency of the filters is immaterial at Brunswick. The discharged stock is fed to a low density storage chest after which the consistency is adjusted with unthickened stock. The bleach plant takes stock at 3 to 4% consistency. Hence the interest is primarily water removal with consistency a minor factor. In this detail the machines seem about equal.

Maintenance is not a problem with either machine aside from minor troubles with take-off roll bearings. Neither machine has had any down time worth considering. Both machines have their original face and winding wires although it appears that the wire on the vacuum filter should now be replaced. This unit has been in continuous operation since early 1948. The valveless filter was installed late in 1950.

CONCLUSIONS

Under present operating conditions, both machines have essentially the same pulp and water capacities. The discharge consistencies are also about the same with less variation on the valveless filter. Floor space is about equal for both filters with the vacuum filter extending further upward. The over-all capital requirements favor the valveless machine over the vacuum machine about two to three, chiefly because of the lower installation costs and fewer auxiliary equipment required. The lower cost for auxiliary equipment is due mainly to lower head pumps requiring less horsepower, and the elimination of the drop legs and seal pits. The operation of the valveless filter is simpler and steadier. Maintenance costs for both are low. The balance of all factors would favor the valveless installation under the conditions examined.

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ASSOCIATION NEWS AND EVENTS

Corrugated Containers Session

Four 3-hour panel-type discussions are being prepared for the annual meeting program being sponsored by the TAPPI Corrugated Containers Committee.

The meeting to be held on Tuesday morning, February 6, will be devoted to a consideration of the "Easy Opening Box."

Theodore Ley of the Corrugated Box Machinery Co. will describe equipment for applying tape and discuss possible production speeds.

E. L. Decker of Minnesota Mining and Manufacturing Co. will present a motion picture, depicting the use of their tear strip.

The meeting of Tuesday afternoon will consider the "High Humidity Box."

L. J. Hayhurst of Kraft Foods Co. will discuss the requirements of packages in the cheese industry.

W. Sederlund of National Starch Products, Inc., will present a paper on "Case Sealing Adhesives for High Humidity Container Storage."

Claude H. Fletcher of Corn Products Sales Co. will discuss "Corrugating Adhesives for Use with High Humidity Containers Such as Those with Sulphur Impregnated Corrugating Medium."

Charles Zuzi will discuss field tests and indicate how various types of containers stand up.

The meeting to be held on Wednesday morning, February 7, will feature "Heat Balance and Its Effect on Corrugated Board."

The final session to be held on Wednesday afternoon will be a general technical session.

F. D. Long of the Container Corp. of America will present an analysis of the "Waste Survey" data.

L. O. Carlisle will discuss "The Importance of Viscosity Control of Corrugating Starch."

Wm. Schoenberg of Lord & Schoenberg will talk on "The Effect of Moisture Variation on Standard Corrugating Test Procedures."

Local Section Meetings

Pacific: West Linn, Ore., March 19, 1945. Annual Shibley Award Competition.

Lake States: Hotel Wausau, Wausau, Wis., March 9, 1954. Symposium on "Testing Methods." G. J. Brabender, Marathon Corp., Rothschild, Wis., moderator. Plant visit to Wausau Paper Mills, Brokaw, Wis.

Delaware Valley: Engineers Club, Philadelphia, Pa., Jan. 8, 1954. "Semichemical Pulping."

Kalamazoo Valley: Hotel Harris, Kalamazoo, Mich., Feb. 1954. "Alkaline Sizing."

New England: March 9, 1954.

Ohio: American Legion Hall, Middletown, Ohio, Feb. 11, 954. "Printing, Past, Present, and Future," by W. C. luebner, Huebner Laboratories, Mamaroneck, N. Y.

Empire State: Whiteface Inn, Lake Placid, N. Y., June 0–13, 1954. Annual Meeting.

Empire State (Metropolitan District): Fraunces Tavern, ew York, N. Y., March 9, 1954.

Empire State (Northern District): Martinas Restaurant, atertown, N. Y., Feb. 11, 1954.

Empire State (Central District): University Club Syracuse, N. Y., Feb. 5, 1954. "The Manufacture of Tissues," by Wm. H. Hall, Victoria Paper Mills, Fulton, N. Y.

Empire State (Eastern District): Milfranks Restaurant, Glens Falls, N. Y., Jan. 21, 1954. "Routine Control Methods."

Empire State (Western District): Prospect House, Niagara Falls, N. Y., Feb. 3, 1954. "High Density Super Bleaching of Chemical Pulps," by F. R. Sheldon and I. C. MacGugan, Buffalo Electro-Chemical Co., Buffalo, N. Y.

Maine-New Hampshire: Marshall House, York Harbor, Me., June 18–19, 1954. A. E. Jones, Oxford Paper Co., Rumford, Me., and F. N. Sprague, St. Regis Paper Co., Bucksport, Me., will be in charge of the technical program.

Lake Erie: Hotel Carter, Cleveland, Ohio, Feb. 19, 1954.

Southeastern: George Washington Hotel, Jacksonville, Fla., March 19, 1954.

CPPA Technical Section: Empress Hotel, Victoria, B. C., June 14–17, 1954. Summer meeting.

American Pulp and Paper Mill Superintendents Association: Mount Royal Hotel, Montreal, P. Q., June 20–23, 1954.

Local Section House Organs

Following the lead of the Ohio Section which has been issuing a local publication for the benefit of its members (*Ohio Tappi*) other sections recently have initiated similar publications.

New England Tappi made its appearance as an 8-page bulletin in November. It gave the details of its December 14 meeting with brief biographical sketches of the speakers. The chairman in his notes indicated a new policy to be followed this season of discussing at each meeting some aspect of stream improvement and quality control statistics. In addition there will be presentations on other subjects. A report is given of the October 9 meeting including the talks given.

In both the Kalamazoo Valley Section and the Delaware Valley Section a mimeographed News Letter is sent out with the meeting notices.

The Southeastern Section issued Vol. I, No. 1, of its new *Southeastern Tappi Bulletin* in which the December 4 program is outlined. An excellent report with photographs of the September 25 program is given.

These sections rate good commendation for these efforts to serve their members. The "pay-off" represented by interest and meeting attendance should be excellent.

Pulp Testing Committee

Frank E. Caskey of the Central Research Dept., Crown Zellerbach Corp., Camas, Wash., has succeeded R. I. Thieme of the Scott Paper Co. as chairman of the TAPPI Pulp Testing Committee.

Associated with him as committeemen are:

J. R. Arthur, Port Huron Sulphite & Paper Co., Port Huron, Mich.
C. E. Brandon, Aetna Paper Co., Howard Paper Mills, Dayton, Ohio
Elmer A. Christopherson, Scott Paper Co., Everett, Wash.
James d'A. Clark, Consultant, Longview, Wash.
F. A. Delforge, Robert Gair Co., Uncasville, Conn.
G. C. Kimble, Union Bag & Paper Corp., Savannah, Ga.

N. Magnusson, Puget Sound Pulp & Timber Co., Bellingham, Wash.
F. P. Moden, Anglo-Canadian Pulp & Paper Mills, Quebec, P. Q.
O. H. Sangder, Rayonier, Inc., Grays Harbor Div., Hoquiam, Wash.
H. A. Smith, Mead Corp., Chillicothe, Ohio
R. H. Wiles, International Paper Co., Glens Falls, N. Y.

Visit to John Waldron Corp. Laboratory

The John Waldron Corp. announces the opening of its new research and engineering laboratory at New Brunswick. Among the facilities of the new laboratory is a pilot plant converting line for 20-in. wide webs of paper, textiles, plastics, etc. The pilot plant equipment includes a coater base on which various types of processing equipment can be set up, and several standard coating heads, among which are the new "Uniflo" Microjet Coater and the Multi-Coater, which can be set up as a reverse roll coater, reverse smoothing roll coater, knife coater, one or two side kiss coater, impregnator, laminator, engraved roll coater, or engraved roll offset coater. A wide range electronically controlled drive is provided for speeds from 5 to 1000 f.p.m. with provision for increasing the speed to 2000 f.p.m. Drying is effected by means of a newly designed J. O. Ross air drier of the indirect oil-fired type, 24 ft. long, with three zones of individually controllable temperatures up to 500°F. Completing the line are a two-spindle automatic splicing unroll, a combination conveyor-tenter frame, a four-roll cooling section, an automatic web guide, and a two-spindle automatic rewind with controlled tension drive.

In addition to the pilot plant equipment, the 70,000-cu. ft. research and engineering building includes the development machine shop, a design section for the engineering of the new equipment, and several engineering offices. The entire building is air conditioned with the exception of the pilot plant area, which is provided with high volume ventilation for comfort and removal of solvent fumes.

Mixing equipment is available for the compounding of coating formulations and various instruments are used for development purposes, such as the Beta Gage for measuring coating weights by means of radioactive isotopes, oscilloscope for determining torsional vibrations, and various instruments for determining air flow, pressure, temperature, electrical voltage, current, power, etc.

The pilot plant equipment is available to papermakers and converters for evaluation of their products and for investigation of the most suitable method of coating or treating, as well as for the research and development activities at Waldron. In the past few years, hundreds of tests have been scheduled for companies engaged in various types of processing operations, using the equipment in the old Waldron laboratory. With the completely new processing line, the demand for the services of the laboratory is expected to increase.

A visit to this laboratory has been scheduled for Friday, February 19, for interested TAPPI members. Anyone planning to make this visit should contact the John Waldron Corp. representatives at the Hotel Commodore. Transportation to New Brunswick and return will be arranged on a suitable schedule. Special arrangements will be made for any TAPPI member who cannot visit the laboratory on Friday. Write to A. W. Pomper, John Waldron Corp., New Brunswick, N. J.

Annual Meeting Registration

To avoid some of the misunderstanding prevalent at recent meetings of the Technical Association of the Pulp and Paper Industry, members are requested to have their 1954 membership cards available. The registration fee for Association members is usually lower than it is for nonmembers.

Seventh Alkaline Pulping Conference

The Seventh Alkaline Pulping Conference of the Technic Association of the Pulp and Paper Industry was held at t Rice Hotel, Houston, Tex., on Nov. 18–20, 1953. Fred W Bishop of the Southland Paper Mills, Inc., Lufkin, Te chairman of the Alkaline Pulping Committee, was gener chairman of the Conference, Ken D. Running of the Halif Paper Co., Roanoke Rapids, N. C., was chairman of the Pr gram Committee.

The Advisory Committee consisted of W. R. Crute of t Champion Paper & Fibre Co., Pasadena, Tex., and W. McHale of the Southland Paper Mills.

The local arrangements were handled in an excellent ma ner by I. D. Wells of the Champion Paper & Fibre C Associated with him were J. H. Moyer, J. K. Kirkpatric Malcolm N. May, R. L. Betts, Glenn Surathers, John Pa rott, O. K. Sanders, Stephen Chase, Jr., and Jack Pound.

The meeting was attended by about 350 members an guests together with about 50 wives of members. An inte esting program was arranged for the ladies at the Golfcre Country Club and the Shamrock Hotel.

All present enjoyed a get-together party at the Rice Hot on the evening, of November 18 sponsored by the Champio Paper & Fibre Co. and the Southland Paper Mills, Inc.

The main theme of the technical program was "Washin and Screening of Alkaline Pulp." One session was devot to semichemical pulping and miscellaneous subjects.

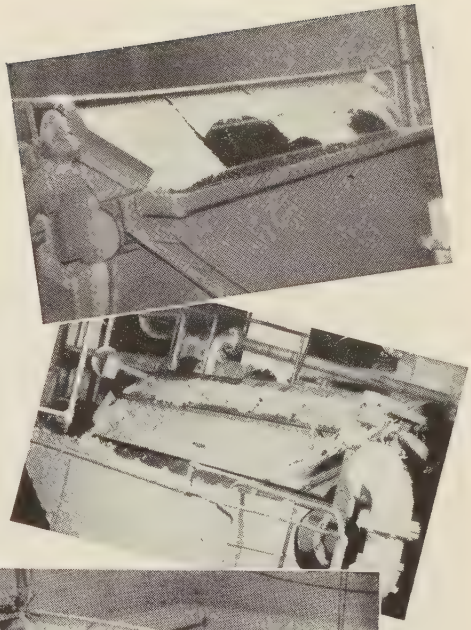
Tuesday, November 20, was devoted to visits to the mil of the Champion Paper & Fibre Co. at Pasadena, Tex., an to the Southland Paper Mills at Lufkin, Tex.

Pulp Washing

Fred W. Bishop presided at the first technical session whic was devoted to a consideration of pulp washing. Comple text of the papers will be published in *Tappi*. Following a some of the highlights presented:

I. D. Wells, Champion Paper & Fibre Co. and R. G. Mac donald, TAPPI

LOW COST recovery of HIGH COST paper stock



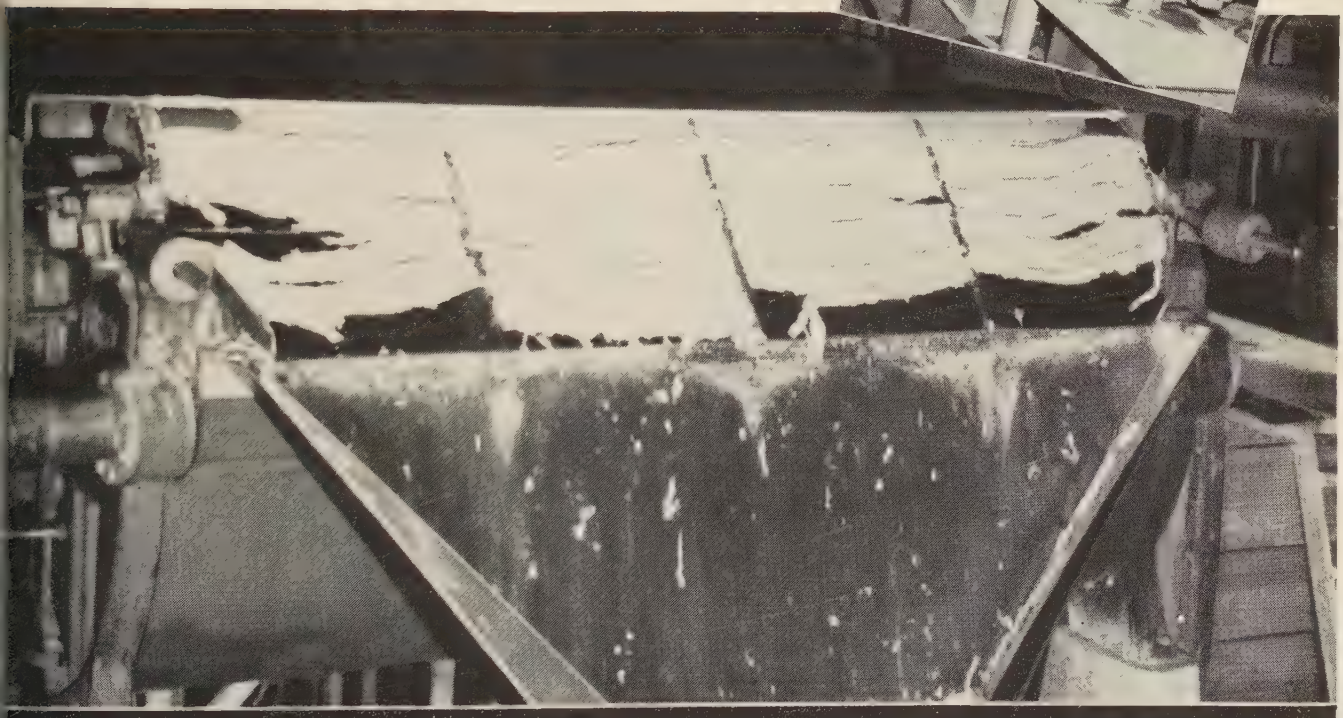
— that's what you're looking at in these pictures of Bird Save-Alls at work.

— and that's what you'd better make sure of in *your* mill

1 by providing enough Save-All capacity to handle your present volume of white water, and

2 by setting up a good, tight up-to-the-minute system that will recover a maximum amount of stock at lowest cost per ton

BIRD SAVE-ALLS



BIRD MACHINE COMPANY

SOUTH WALPOLE • MASSACHUSETTS

J. M. Ralston, Union Bag & Paper Corp., and J. K. Perkins, Improved Machinery Corp.

J. M. Ralston presented a paper, co-authored by Maurice Klein of the Union Bag & Paper Corp., Savannah, Ga., on "Wash Water and Wash Water Heating." In this paper the requirements of the wash water used on the diffusers and pulp washers in their mill were presented. The digester blow steam is condensed directly with fresh water make-up in jet condensers. Instrumentation of the system is designed to control the temperature of the hot water to the washing equipment, accumulate the maximum amount of heat, and control fresh water make-up. Waste heat from an evaporator surface condenser is used to heat part of the water supplied to the hot water system. Other sources of waste heat are available if the need for additional heat should arise.

Valveless Washer

J. K. Perkins, Improved Machinery Corp., Nashua, N. H. presented a paper on "The Valveless Rotary Vacuum Washer." In this paper he pointed out that the valveless washer may be used in place of the vacuum rotary washer with the added advantages of low elevation or eliminating of an external source or vacuum. On new installations built around the valveless design full advantage can be taken of the low elevation requirements to allow lower building costs, installation costs, piping costs, and pumping expense.

Pulp Washing at Thilmany

A paper on "Sulphate Pulp Washing at Thilmany" was presented by P. H. West of the Thilmany Pulp & Paper Co., Kaukauna, Wis., T. T. Collins, National Container Corp., Jacksonville, Fla., and R. E. Bergstrom, Swenson Evaporator Co., Chicago, Ill. In this paper part of the modernization program at Thilmany was described. Formerly the washing system consisted of 16 diffusers with a washing cycle of about 10 hr. which limited production to 160 tons of pulp. The new system consists of three 9 by 16-ft. Swenson washers, together with auxiliary pulp washing equipment consisting of a 22-ft. diameter blow tank provided with a vertical bar-type agitator. Two Jonsson knotters preceded the Swenson washers. By use of the new system 225 tons of pulp can be handled.

Luncheon Program

Following the annual luncheon of the Conference an address was made by Karl R. Bendetsen of The Champion Paper & Fibre Co. on "What is Public Relations?" This address, which is being published in this issue of *Tappi*, concludes with the statement "If your actions are such as to make people have confidence in you, then you can say that your public relations are good. If your actions or words lead to lack of confidence in you, then your public relations are bad. It's about as simple as that." W. L. McHale of Southland Paper Mills, Inc. presided at the luncheon meeting.

Effect of Digester Operation

The second session which was held on Wednesday afternoon was moderated by Ken D. Running of the Halifax Paper Co. The first paper prepared by William Orr on "The Effect of Digester and Liquor Room Operation on Pulp Washing" was read by L. L. Clapp, also of the St. Regis Paper Co., Pensacola, Fla., since Mr. Orr was unable to be present because of illness.

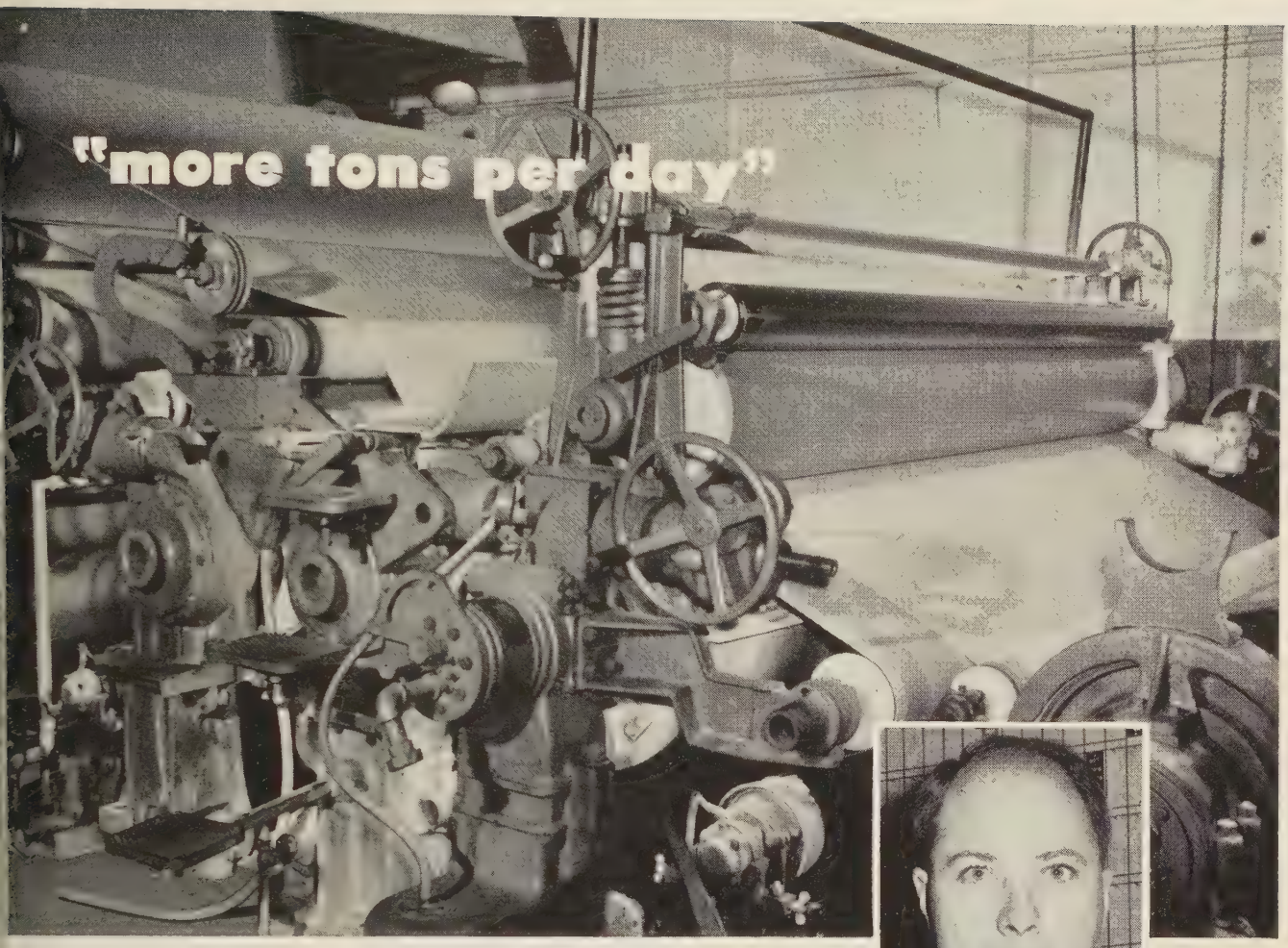
In this paper the author made a report showing different operating procedures in the digester and liquor rooms and their effects on wash room operation. It was shown that the following digester variables influence production and efficiency of the wash room: (1) stock availability and permanganate number; (2) overcooked stock washes slowly; (3) increased density of digester change results in greater wash room production; (4) rejects and their disposal have a marked effect on washer operation; (5) the color of washed stock is dependent upon residual activity of spent cooking liquor and dilution liquor used for volume; (6) the effect of the digestion on pitch will affect wash rooom operation.

The liquor room operation has the following effects on wash room performance: (1) foreign material such as mud or dregs in cooking liquor will create difficult washing conditions; (2) the capacity of the wash room is increased by decreasing the concentration of black liquor; and (3) high sulphidity tends to decrease wash room capacity.

Four-Stage Washer vs. Three-Stage Washer

E. A. Paul of the Hudson Pulp & Paper Co., Palatka, Fla., read a paper prepared by him and E. A. Harper on "The Efficiency of a Four-Stage Washer versus a Three-Stage Washer." This investigation over the operating period of a year in a kraft pulp mill was made to ascertain the relative efficiency of the two units. A brief description was given of the closely controlled operation necessary to produce an

E. A. Paul, Hudson Pulp & Paper Co.; A. L. Wiley, Riegel Carolina Corp.; L. L. Clapp, St. Regis Paper Co.; E. H. Smith, Crossett Paper Mills, K. D. Running, Halifax Paper Co.; and M. B. Pineo, Brunswick Pulp & Paper Co.



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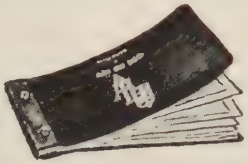

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F. C. Ratliff, Gaylord Container Corp.; Pietro Ghisoni, Vita Mayer Co.; M. B. Pineo, Brunswick Pulp & Paper Co.; Gustaf Ranhagen, Swedish Cellulose Co.; and R. E. Bringman, Port St. Joe Paper Co.

almost equal quantity of the same quality of washed pulp. It was concluded that the quantity and quality of washed pulp being equal, the dilution factors become the measure of the relative efficiency and that the three-stage washer is about 77% as efficient as the four-stage washer.

Cowan Screens

E. H. Smith read a paper on "Performance of Cowan Screens on Kraft Pulp," by W. S. Gardner, E. H. Smith, and C. L. Brown of the Crossett Paper Mills, Crossett, Ark.

The early experience with Cowan Screens on kraft pulp was not satisfactory. The capacity of screens was low and water and power usage was high compared with predicted results obtained in other Southern mills on kraft pulp. All of our early experience was obtained with 0.085-in. perforations on $^1/_8$ or 0.125-in. isometric centers.

Later tests with 0.085-in. perforations on $^7/_{32}$ or 0.219-in. isometric centers indicated a capacity only slightly below that obtained with 0.085-in. perforations on $^1/_8$-in. centers. This change in spacing of perforations gave a tremendous reduction in total number of perforations in a set of plates. A set of Cowan plates with perforations on $^1/_8$-in. isometric centers contain approximately 300,000 perforations while the same plates with perforations on $^7/_{32}$-in. isometric centers contain approximately 100,000 perforations.

Further tests were made with 0.085-in. perforations on 0.1445-in. isometric centers. Immediate results showed greatly improved performance. They were able to operate the screen at predicted capacity with lower water and power usage than had been necessary for highest tonnage obtained in tests with other plates.

Ahlfors Screen

Roy Homans and Malcolm Pineo of the Brunswick Pulp and Paper Co., Brunswick, Ga., presented a paper on "Flat Screens vs. Ahlfors Screens for Bleachable Pine and Hardwood Sulphate Pulp."

This investigation was limited to a comparison of the Ahlfors upflow screen and a conventional flat screen in regard to pulp cleanliness, capacity, maintenance, and flexibility of operation as applied to southern pine and hardwood bleachable sulphate pulp. To complete the study, pine and hardwood unbleached sulphate pulp, commercially washed and deknotted, was admitted to the screen room headbox from where it was introduced into an Impco flat screen line and an Oliver-Ahlfors upflow screen simultaneously. Production rates, screened stock cleanliness, quantity of rejects, consistencies, temperature of stock suspension, operating conditions of the two screens, were measured, recorded, and correlated.

Unbleached pine pulp was screened at consistencies o 0.8 to 1.2% on an oven-dry basis through the Ahlfors scree at rates averaging 26 oven-dry tons per day. Unbleache hardwood pulp, at consistencies ranging from 1.4 to 1.7% oven-dry, was screened at rates averaging 45 oven-dry ton per day. These capacity ratings approximate that obtaine on two sections, 28 plates, of flat screens at consistencies o 0.5% oven-dry for pine and 0.75% oven-dry for hardwoo Screen plates having 0.12-in. cuts were used in both the Ah fors and flat screen installations.

The input shaft speed on the Ahlfors screen had a direc bearing on the capacity of the screen. When the input sha speed was increased from 1300 to 1420 r.p.m., an increase o 18% of acceptable stock was realized.

No appreciable difference in capacity could be noted b varying the input stock consistency from 0.68 to 1.55%. Stock temperature changes from 78 to 118°F. increased th capacity of the Ahlfors screen by approximately 20%.

Under optimum conditions of operations, excluding th effect of temperature, it can be said that the screened pul from the Ahlfors screen compared favorably with the fla screens in regard to dirt and shive removal.

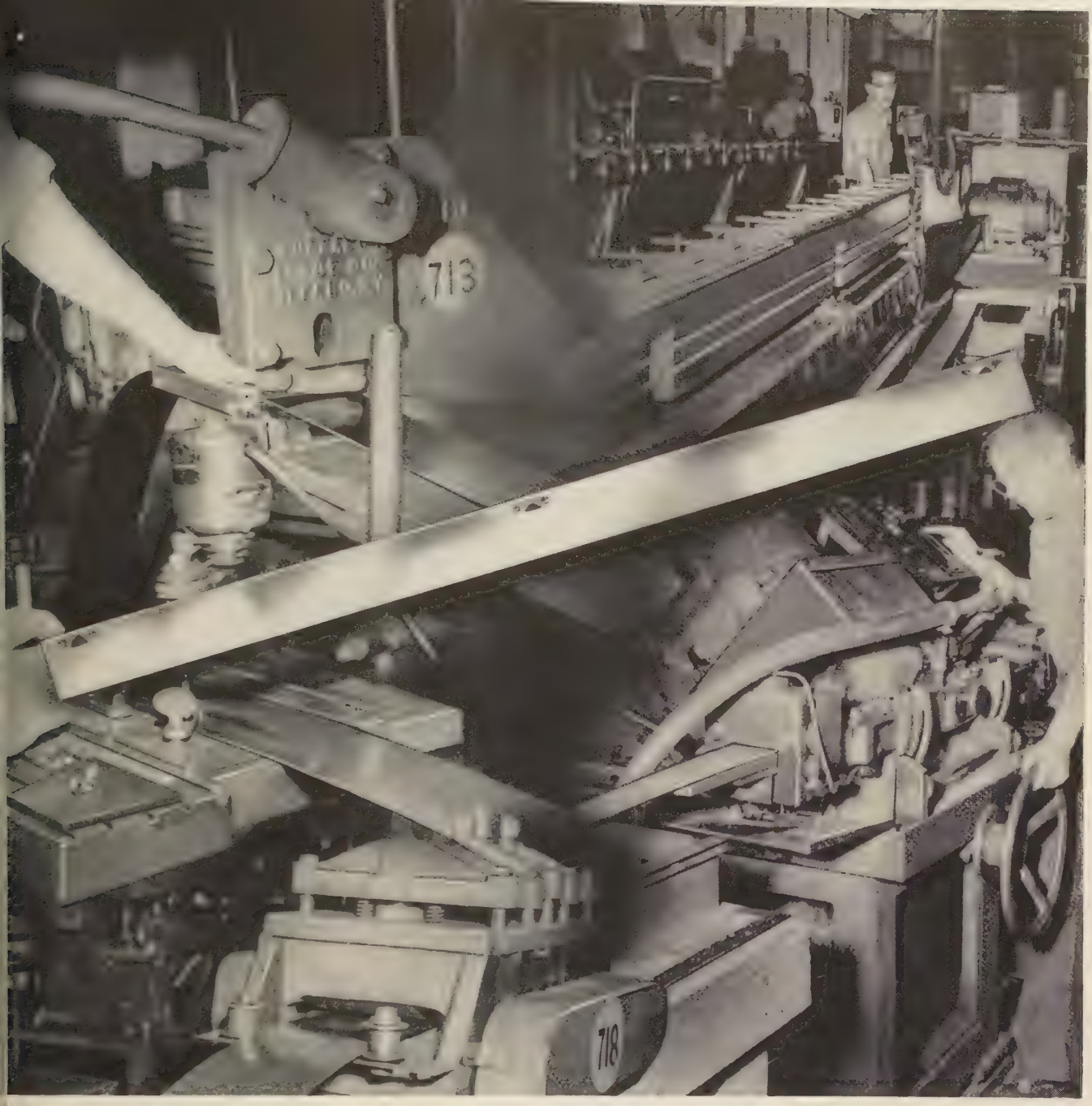
Centri-Cleaners

A. L. Wiley read a paper on "The Use of Centri-Cleaner and Vortraps on Semichemical Pulp" by the Riegel-Car lina Corp., Acme, N. C.

The need of a cleaner pulp than could be obtained wit flat screens brought about the use of Centri-Cleaners in th semichemical system at the Riegel-Carolina Corp. mil The original system using six primary and one secondar Centri-Cleaners, size 12 by 2 by 2 in. with $^3/_4$-in. tips, re jected 25% of the entering stock as compared to an expecte rejection of about 2%. Various modifications and tests le to the incorporation of Vortraps in the system as tertia cleaners. This addition reduced the rejections to abou 0.3% of the initial feed. Further work, with the Centri Cleaners produced rejects which could be used in the kra system; thus making the use of the Vortraps unnecessary.

The system now in use consists of three 12 by 3 by 3-i primary cleaners with $1^1/_8$-in. tips and one 12 by 2 by 2-i secondary cleaner with a $^3/_4$-in. tip. Accepted stock fro the primary and secondary semichemical flat screens is passe to the primary Centri-Cleaners. The rejects from thes cleaners are diluted and form the feed of the secondary cleane Accepted stock from both the primary and secondary Centri Cleaners is sent to the semichemical decker. Rejects fro

Pietro Ghisoni, Vita Mayer Co., Milan, Italy; and Jerrol H. Moyer, Champion Paper & Fibre Co.



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D. J. MacLaurin, The Institute of Paper Chemistry; L. G. Durant, Pandia, Inc.; William Nelson, Green Bay Pulp & Paper Co.; and J. N. McGovern, Forest Products Laboratory

the secondary Centri-Cleaner amounting to 8 to 11% of the initial feed are pumped to the primary kraft flat screens for recovery. The recovery of rejects from the secondary Centri-Cleaner has no adverse effects on the kraft pulp. The system is capable of handling a feed of 70 air-dry tons per day.

Mr. Pineo of the Brunswick Pulp & Paper Co., Brunswick, Ga., was the moderator of the Thursday afternoon session.

Flat Screens

The first paper was presented by H. F. Schenk of Magnus Metal Corp., Fitchburg, Mass., who discussed "Selective Particle Separation by Controlled Fluid Force on a Flat Screen."

In this paper Mr. Schenk advocated the employment of gravimetric and more gentle forces of nature rather than those forces imparted by high frequency pulsations employed in other types of speck-removal equipment. Among other things he pointed out that between a flow created for a 28-plate line, it has been found that two 14-plate units, arranged in parallel, developed not only the highest capacity but also the cleanest pulp.

High Intensity Screens

F. Cooper Ratliff of the Gaylord Container Corp., Bogalusa, La., presented a paper on "The Use of High Intensity Screens in Handling Sulphate Pulp for Coarse Papers." Mr. Ratliff reported that a Lindblad high intensity screening system was recently installed in Gaylord Container Corp.'s Bogalusa, La., sulphate pulp mill. This paper dealt with the problem involved in expanding the screening operation.

Economic studies by process engineering and construction engineering showed that while high intensity screens themselves were more expensive than other types the over-all installed cost was considerably less.

It was expected that a maximum capacity of 500 tons of air-dry pulp per day through four Lindblad high intensity screens connected as planned would be obtained. The quality of the pulp was expected to be satisfactory for manufacture of cylinder liners, wrapping, and bag papers.

Test results showed that expected performance was obtained and it is believed that this type of screen was a satisfactory solution to the specific problem.

Jackson & Church Press

R. E. Bringman, chief chemist of the St. Joe Paper Co., Port St. Joe, Fla., discussed "The Use of a Jackson & Church Zenith Press in Handling Pulp Mill Rejects." He pointed out that the evolution of reject-handling systems at the St. Joe Paper Co. mill was twofold. An effort was made to follow very closely the development of process equipment that would yield high density rejects to their refining system thereby reducing the amount of dilution water fed to the blow tank which must eventually be evaporated in the vacuum evaporators.

With the incorporation of high-yield hot stock refining, the need for a different method of handling rejects became evident. Through the use of a Jackson & Church press it was possible to send 35 to 40% consistency rejects to the blow tank for subsequent recycling through the hot stock refining system.

Laboratory investigations bore out the feasibility of passing high-consistency rejects directly into a high-density refiner without first rediluting with black liquor and passing them through conventional refiners thereby reducing the power load and increasing the capacity of the refining and brown stock washing system.

Swedish Practice

An interesting feature of the meeting was the presence of Gustaf Ranhagen of the Swedish Pulp Co., Sundsbruk, Sweden, who presented a paper on the subject "Screening of Sulphite Pulp." The highlights of his paper follow:

The screening problem has in Sweden become more and more important due to the raw material situation and market demands on quality.

Different types of screen equipment are collected into groups according to their construction and way of working and compared as to their dirt-removing properties.

Different dirt particles are considered with reference to different types of screen equipment.

In order to obtain the best result where cleanliness, capacity as well as water and power consumption are concerned, the optimum consistency should be kept at every point along the screen surfaces. This is generally valid to all screens of de-watering type. The occurrence in a screen is illustrated by a figure.

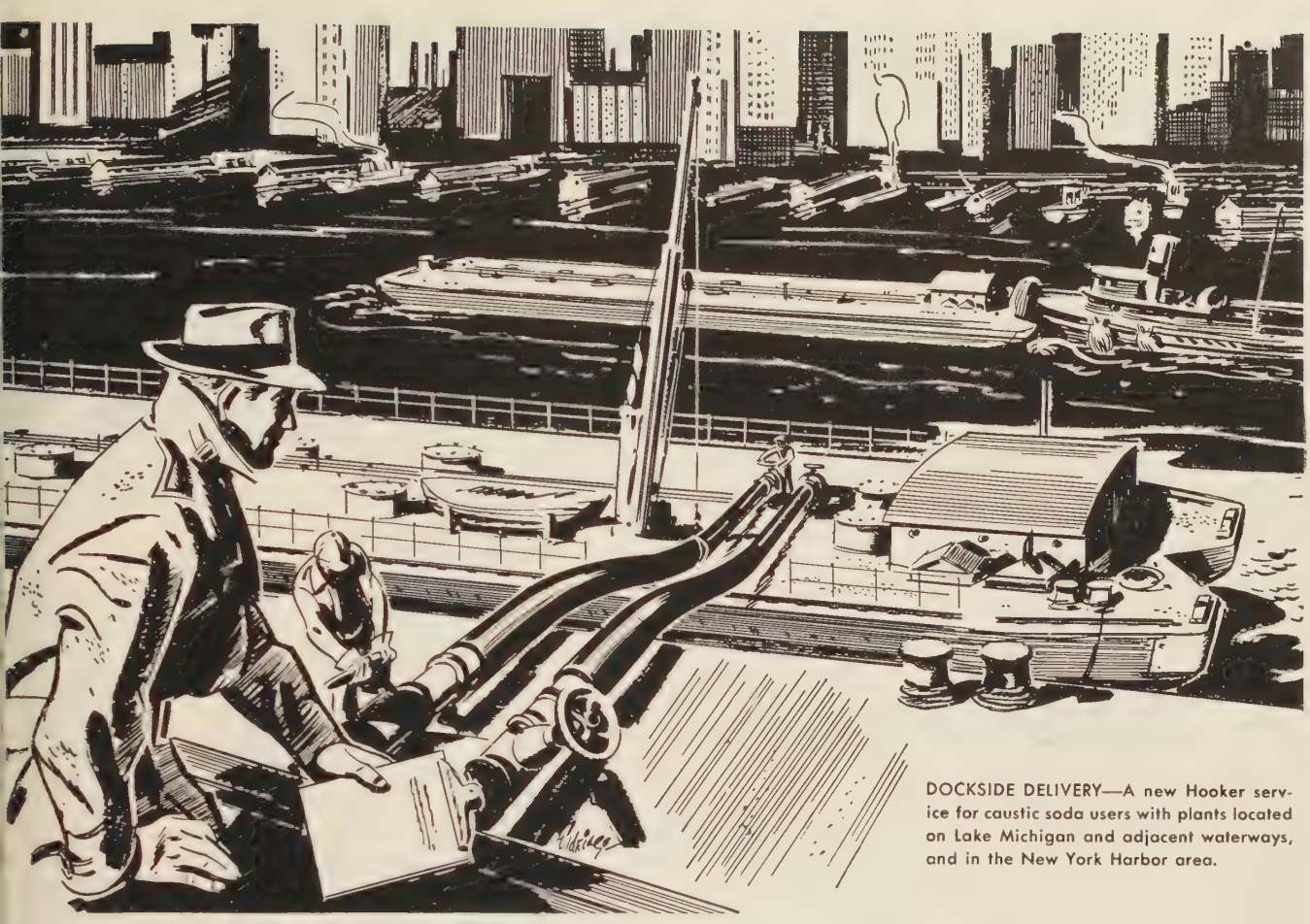
It is stated that none of the screens in the market gives a good result in all respects but different groups mentioned have their own very marked effect.

A combination or double screening is to be preferred when the demand on cleanliness is high. The modern high frequency vibratory screens, centrifugal screens, and vortex cleaners give good possibilities of combination. At double screening with high frequency vibratory screens with slotted plates in combination with centrifugal screens, the best results have been obtained when the former has been placed first in the series.

The system used is of higher importance than the individual screen. The system should be designed to permit each integrated unit to work at optimal conditions.

The design of the secondary and tertiary part of the screen room is of vital importance for cleanliness and economy

I. D. Wells and Karl R. Bendetsen, Luncheon Speaker, of the Champion Paper & Fibre Co.



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The accepted stock from the secondary and tertiary screens should be recirculated to the charge of the primary screening. A couple of flow sheets are discussed.

The double screening is theoretically motivated with statistical points of view. For selective screening to be valid, when the statistical laws are taken into consideration, every single screen in a combination of two, needs to be the square root of the single screen to give the same result.

Odor Elimination

Another added feature to the technical program was a paper presented by Pietro Ghisoni of Vita Mayer & Co., Milan, Italy, on "Elimination of Odors in a Sulphate Pulp Mill." His paper was read by J. H. Moyer of the Champion Paper & Fibre Co. In this paper the author indicated that because of the unique location of his mill in a valley near Milan it was necessary to eliminate odors from the nearby city completely. Good results were obtained by burning all of the noncondensable gases coming from the digester relief and the blow of the pulp cooking in a natural gas-burning boiler. Complete oxidation of the condensate coming from the relief was effected and finally the malodorous sulphur compounds contained in the smoke of the furnace burning black liquor were oxidized. The smoke was washed with chlorine water and cooled to the dew point and later heated by mixing with smoke of a higher temperature coming from another boiler

Semichemical Pulping

The Thursday afternoon program was devoted to "Semichemical Pulping." J. N. McGovern of the Forest Products Laboratory, Madison, Wis., presided as moderator.

Mr. McGovern read the first paper which was prepared by Friedrich A. Aflenzer of the Technical University of Graz, Graz, Austria, on "The Influence of Fiberizing Variables in Producing Semichemical Pulp in a Commercial Disk Mill."

The author advised the attrition mill usually used in refining semichemical pulp is essentially a fiberizer. He advocated having the refining operation carried on in two steps: first, fiberizing, and second, strength development of the fibers. The chips should have a moisture content of at least 60% since moisture content has much influence on strength properties of pulp and also on energy consumption.

High-Yield Kraft Pulping

D. J. MacLaurin and J. F. Whalen of The Institute of Paper Chemistry, Appleton, Wis., presented a paper on "Continuous High Yield Kraft Pulping of Douglas-Fir Lumber Waste."

The authors reported that a range of high yield (60 to 70%) Douglas-fir kraft pulp was prepared in an apparatus simulating a commercial chemipulper, from composites and fractions of hammermilled box ends, chipped slabwood, chipped tops and limbs, and chipped logs. The better pulps had handsheet crush and other strength properties about equal to those obtained from typical average corrugating medium pulps. In general, yield decreased with decreasing chip size and increasing cooking chemical and pressure. Strength increased with increasing chip size and decreasing yield. The black liquor solids calorific values ranged from 6500 to 7500 B.t.u. per pound of solids.

Va-Purge Process

In addition to the regular program which has been reviewed briefly two additional informal talks were given by L. C. Durant of Pandia, Inc., New York, N. Y., and William Nelson of Green Bay Paper & Pulp Co., Green Bay, Wis. Mr. Durant's remarks follow:

If my memory serves me correctly, it was some time back in the 1920's that the Pulp & Paper Research Institute of Canada began publishing the results of its studies on chip penetration. This work went on for several years and covered wide varieties of wood, liquors, as well as physical and chemical conditions.

I think that the recently patented Va-Purge technique can be attributed almost directly to the thoroughness of this work.

It is not my function to give you a treatise on Va-Purge. All of this work has been published and explained much better than I could ever hope to tell you about it. John McGovern, your chairman, has asked that I make a few informal remarks on the "Application of Va-Purge to Continuous Cooking." Va-Purge is a method of accelerating forced and natural penetration of liquors and chemicals into wood. It is a method of getting liquor to completely penetrate a chip in a very short period of time.

The Va-Purge process is so named because it makes use of steam to purge the noncondensable gases from the chips and is actually, therefore, a pretreatment process.

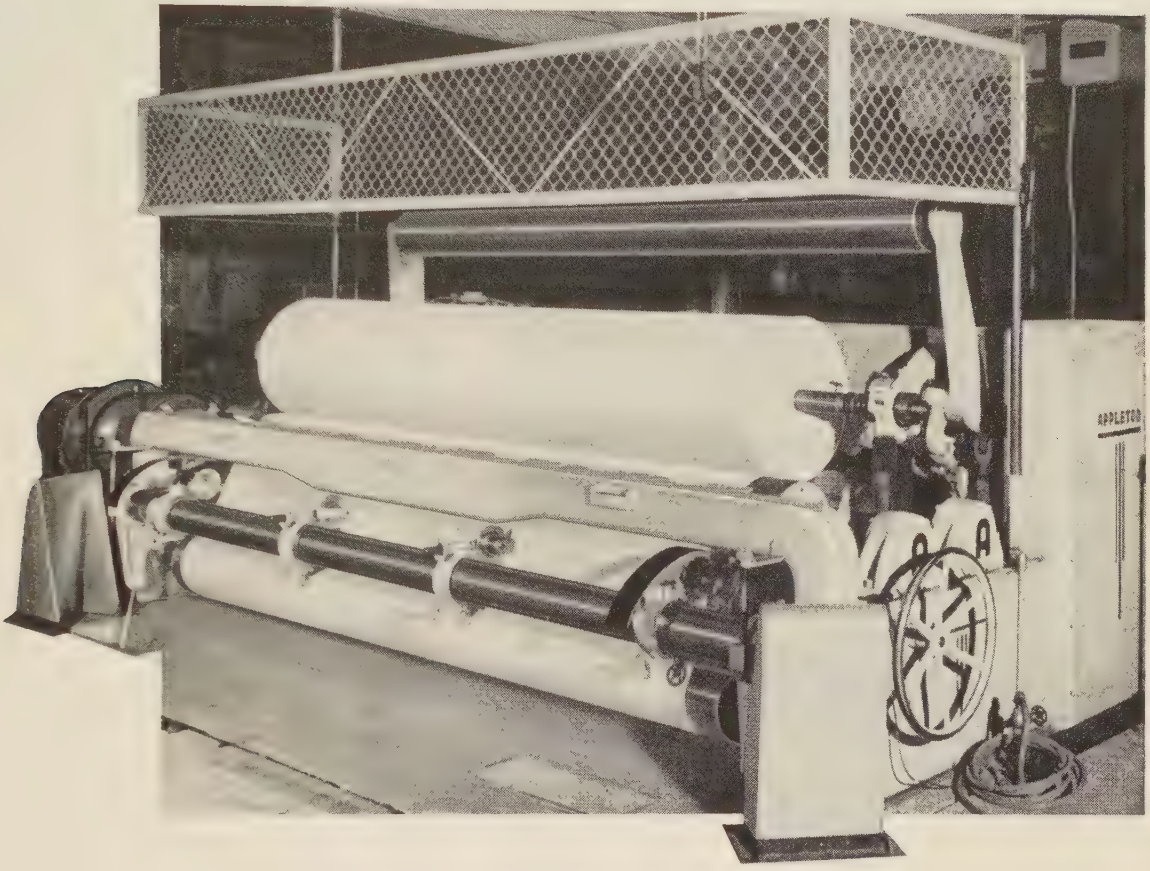
Purging of the chips is accomplished by use of steam and is carried out under pressure. The purge pressure is rapidly built up to a predetermined point and is generally held at this level for a minute or so. The pressure is then rapidly reduced to a predetermined lower level. This procedure may be repeated once, twice, or more times, each purge removing a fraction of the air in the vessel as well as the air within the chips, which fraction is determined largely by the magnitude of the rise and fall of the pressure.

When the purging has been completed, the chips should be more uniform in moisture content and should be prepared to readily accept the liquor. Liquor of desired composition is run in to completely cover the chips without permitting reintroduction of air. It is probably necessary to carry this step out under pressure if the final pressure of the purging cycle is above atmospheric pressure.

When the liquor is sufficient to completely cover the chips, it is all brought under a predetermined pressure and maintained at that pressure for sufficient time to allow complete penetration of liquor and diffusion of the chemical through the chips. This tends to establish an equilibrium concentration of chemical in all of the liquid in the vessel.

This step is of relatively short duration and is the essence of

for over 70 years...



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the Va-Purge process. When the penetration and diffusion cycle have been completed the wood is ready for cooking. The chips are now completely penetrated and it is possible to raise the temperature quickly to cooking temperatures without fear of burning the chips.

The foregoing is Va-Purge technique but in order to make the best use of this development we will spend a couple more minutes discussing cooking and then I will try to briefly explain to you how we at Pandia think the process can be done continuously.

In the Va-Purge treatment the wood will have taken up chemical of sufficient strength to allow it to be completely pulped. The excess liquor, after the impregnation stage, may be removed and the cooking can be carried out by the introduction of direct steam at the proper pressure. This excess liquor may be fortified and used again and again. The chips are cooked with only the liquor which they can hold. This technique, called vapor phase cooking, when combined with Va-Purge has produced pulp of extreme uniformity in a relatively short over-all cycle.

Now to accomplish these techniques in standard equipment presents some obvious problems. Raising the temperature of a digester full of chips to pressure and trying to relieve this pressure quickly takes time. Filling with liquor and draining large volumes of liquor through the chips is also very time consuming. That there are advantages in pulp quality and/or production is evidenced by the work at Ocean Falls and at Champion International according to reports published and read at the Summer Technical Section Meeting, CPPA, at Saranac Lake.

On the other hand, it is obvious that when the holding time at pressure for purging is only 1 or 2 minutes with rapid relief specified, and the holding time for impregnation with kraft liquor may be only 10 minutes, with no lag between these phases needed, then it seems that the proper way to get the ultimate in accomplishment is by means of a continuous system.

Here in front of you is a print of a drawing showing how we at Pandia believe this can be done best, and you will see that the proposed design is entirely continuous.

1. Chips are fed to purge pipe continuously by means of a feed screw.
2. Purging is accomplished by raising steam pressure to a predetermined level—holding for the proper interval and relieving—all on controlled time cycle, as the chips are progressing forward through the tube.
3. Condensate is continuously removed from the bottom of this tube by means of strainers.
4. A valving arrangement, probably of a rotary type, will separate the purging tube from the impregnation tube.
5. Purged chips are dumped by the valving arrangement into a tube full of liquor and the tube is kept above a predetermined minimum pressure.
6. We are not entirely certain of the next step. It may be possible to impregnate and cook at the same pressure and this is now being studied.

(a) If so, we propose to allow the chips and liquor to fall free into the next lower tube where by special means, which I will not take the time to explain in detail, the excess liquor is removed for fortification and circulation back to the impregnating pipe, and the chips progress with their impregnated liquor into contact with direct steam, thus being now subjected to a vapor phase cooking, which obviously can be more rapidly accomplished than cooking in the liquid phase, and at lower steam costs.

(b) If it proves inadvisable to impregnate and cook at the same pressure, then we would insert another valving arrangement to separate the impregnation and cooking compartments and proceed in the same way as mentioned above.

Test work tells us that an overall of 45 minutes is adequate to cook good grades of kraft pulp.

I have not described a continuous unit which is working as we have not even built one yet. I might say here that we are building a pilot plant continuous cooker which we hope will be in use in a couple of months. We have, so far, only taken facts, proved and developed by the exceedingly fine work of the Pulp and Paper Research Institute of Canada, and have translated them into mechanical procedure on our drawing boards. That the process can be accomplished continuously goes without saying, because when facts and procedure have been so definitely established it is always reasonably simple for the engineer to design them into a working machine.

Prepressing

William Nelson of The Green Bay Paper & Pulp Co. described experiments with the press made by the French Oil Mill Machinery Co., now in use in the oil industry, for prepressing the chips for better refining. In this mill chips from the digester can be pressed to a moisture content of from 55 to 35%. Four presses of this type have been made by Bauer Bros. Co. for handling 150 tons per day of pulp at Green Bay.

Panel Discussion

The meeting was closed with a panel discussion. Participating in this panel were: W. P. Lawrence, Champion Paper & Fibre Co., Malcolm B. Pineo, Brunswick Pulp & Paper Co., J. N. McGovern, Forest Products Laboratory, D. J. MacLaurin, Institute of Paper Chemistry, J. E. Sapp, Gaylord Container Corp., C. C. Porter, Southland Paper Mills and Myron G. Kuhlman, Fleming & Sons, Inc.

C. C. Porter presented a problem for discussion, "The Best Method of Utilizing the Hardwood in the Operation of a Mill." In more detail he continued: "As a result of the recent acquisition of Texas Longleaf Lumber Co., Southland Paper Mills has received in this purchase 200,000 acres of timberland which bring their holdings up to 350,000 acres. In this purchase two sawmills were acquired and are continuing to operate on saw timber from these lands. The hardwood encroachment on second-growth pinelands is probably as serious in the East Texas area as it is elsewhere in the South. This hardwood is predominantly 75% post oak and 25% sweet gum. The practice of girdling and poisoning the hardwood has been proceeding on the original 150,000 acres for forest land improvement at quite a high cost. It is estimated that if the mill could produce 25% of its chemical pulp from hardwood, the bulk of this encroachment could be more economically eliminated in the pine producing lands.

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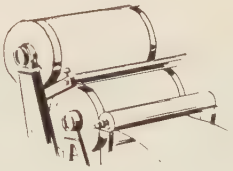

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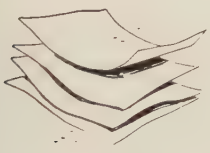

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Impco 8 by 12-ft. washers are employed without any preknotting equipment. All screening is performed in rotary-type screens with the rejects being returned to the digesters. Most of the brown stock is semibleached in a three-stage bleach plant employing direct chlorination, caustic extraction, and hypochlorite. This semibleached pulp is used to satisfy the chemical pulp requirements in the manufacture of newsprint, and in some cases of filler stock requirement for folding grades of paperboard. For liner stock furnish to the cylinder machine, the semibleached pulp is given another hypochlorite treatment to bring it up to 80 brightness.

"As fiber length and strength are required for the manufacture of folding grades of paperboard, the process of hardwood utilization would necessarily require the preservation of these characteristics in a fiber furnish as required for this application."

An exceptionally fine discussion followed this presentation of the problem. Questions and comments came from a large number of the individuals in the audience which kept the panel members busy responding to questions relating to the many aspects of the problem.

At the conclusion of the discussion Mr. Porter said that he had received much useful information from the discussion but he felt that further consideration will need to be given to the problem. It is evident that the semichemical pulping process is still in a state of flux and progressive change.

Fibrous Agricultural Residues Conference

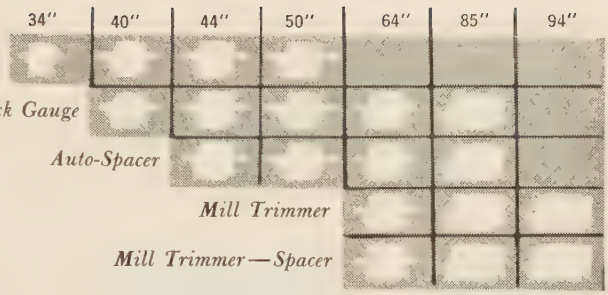
The 10th Annual TAPPI Fall Conference on Fibrous Agricultural Residues had an international setting, being held for the first time in Canada. A two-day session was held on Oct. 8 and 9, 1953, at the Quinte Hotel in Belleville, Ont., located on the picturesque Bay of Quinte on Lake Ontario. This meeting in Belleville came as a result of an invitation from The Hinde and Dauch Paper Co. of Canada Ltd., which operates the only strawboard mill in Canada in nearby Trenton, Ont. Recently this mill had undergone a radical change in its pulping techniques by adopting the Va-Purge pulping process. The technical session of this meeting centered on a round-table discussion on "Crush Resistance and Other Strength Properties of Strawboard." S. I. Aronovsky of the Northern Regional Research Laboratory at Peoria, Ill., chairman of the TAPPI Fibrous Agricultural Residues Committee, was general chairman of the meeting, and W. H. Palm, vice-president of The Hinde and Dauch Paper Co. of Canada, Ltd., was the local chairman. About 35 delegates representing the strawboard industry in the United States and Canada, TAPPI, and the Canadian Pulp and Paper Association, attended this meeting.

Technical Session, October 8

The chairman, S. I. Aronovsky, greeted the delegates and the session commenced with self-introductions of all those present. A cordial welcome to all, and particularly to the United States representatives, was extended by the local chairman, W. H. Palm. All present were invited to see the Va-Purge process in commercial operation at the end of the meeting.

R. G. Macdonald, national secretary-treasurer of TAPPI, spoke on "TAPPI and the Strawboard Industry" (*Tappi* 36, No. 11: 80A). He outlined the objectives of the Association and described many of its numerous activities covering all phases of the pulp and paper industry. New committees are constantly being formed to keep up with newer developments in the industry. One of the most recent is the Statistical Committee; this subject is relatively new but many companies have found it profitable to use this science in solv-

The group attending the 10th Annual TAPPI Fall Conference on Fibrous Agricultural Residues, Belleville, Ont., Oct. 8–9, 1953



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ing their problems and improving operations. Mr. Macdonald described the various TAPPI publications and their functions. TAPPI sponsors many research projects and has special interest in the fibrous agricultural residues because of the large potential source of raw material for the paper industry in this field. Mr. Macdonald stated that there are now over 6000 members with 160 committees and subcommittees in TAPPI.

Harold Balough, John R. Little, Henry J. Ostrowski, Dewitt L. Owen F. A. Dieckbrader, and W. H. Palm of the Hinde & Dauch Paper Co.

E. R. Carpenter, technical director of the Terre Haute Div., Weston Paper and Manufacturing Co. at Terre Haute, Ind., then gave a brief talk on "Properties of Strawboard Corrugating." Mr. Carpenter described the changes that are now taking place in the strawboard industry to meet present-day competition from other corrugating media. A comprehensive cooperative study was undertaken at the Northern Regional Laboratory, Peoria, where more than 80 different straw pulping formulas were checked. Working from these results the Weston Paper Co. made a number of changes in their operations and techniques and were able to upgrade their strawboard corrugating medium to produce a finished box as good as any on the market today.

The round-table discussion on "Crush Resistance and Other Strength Properties of Strawboard Corrugating" was based on a list of 23 questions obtained from a canvas of the strawboard industry. The discussions based on these questions were very lively and were participated in by everyone present. The detailed text of the discussions will be published with the minutes of this meeting at a later date in *Tappi*. Mr. Aronovsky pointed out that straw contains a higher pentosan content than wood and most of the other natural fibers, and, if we assume that the hemicelluloses are mainly responsible for the stiffness of corrugating paper, straw should be the best material from which to prepare such paper. However, more research work is necessary to determine how best to bring out this superior potential of straw for corrugating manufacture. V. E. Bush, manager of The Hinde and Dauch strawboard mill at Ft. Madison, Iowa, stated that it was in the best interest of the country's economy to use more of the abundant annual fibrous agricultural residues to supplement the dwindling wood resources.

The question of testing the crush resistance of corrugating received considerable comment and the feasibility of using a single apparatus and technique acceptable to the whole board industry was pointed out. The chairman appointed a special subcommittee composed of J. R. Little, chairman, and E. G. Carpenter, H. M. Baldin, J. J. Fiori, and W. D. Lewis to investigate the feasibility of mill round-robin testing for comparing the presently available single-flute and Concora flat-crush testers, and to report their findings at the 1954 Fall meeting of this group.

Group Dinner

A social hour sponsored by the Hinde and Dauch Paper Co. of Canada, Ltd. preceded the group dinner. The dinner commenced with toasts to the Queen and to the President of the United States. Mr. Macdonald recounted some of his humorous experiences. Douglas Jones, executive secretary of the Technical Section of the Canadian Pulp and Paper Association, conveyed greetings and best wishes from his organization. Mr. Palm then introduced the speaker of the evening, L. R. Thiesmeyer, president of the Pulp and Paper Research Institute of Canada, Montreal, who gave a most interesting and inspiring after-dinner talk entitled "Peanuts and Progress." This talk will be published in full along with the minutes of this meeting.

Committee Meeting, October 9

There were no regular subcommittee reports. Mr. Aronovsky presented the status of the research project on the preservation of straw in ricks for which the committee had requested TAPPI sponsorship. After some discussion it was decided that this project should be modified and the revised project again submitted to TAPPI.

In making plans for the 1954 Fall meeting, which will be held at the Northern Laboratory in Peoria in accordance with the custom established by this committee, the group decided after some discussion to present two subjects at the Peoria meeting. One involves "Testing of Corrugating Media," and it was suggested that members of the subcommittee on testing of the Corrugating Containers Committee of TAPPI be invited to a joint session on this subject. The second subject chosen by vote of the group was "Stiffness of Strawboard," after discussing two other topics, "Open and Closed White-Water Systems" and "Dirt Removal from Strawboard." All the mills of the strawboard industry will be invited to submit queries on these two subjects prior to the next Fall meeting.

Walter Odze, Separaton Corp.; R. K. Strapp, Pulp & Paper Research Institute of Canada; R. G. Macdonald, TAPPI; C. Gillan, Hinde & Dauch Paper Co. of Canada Ltd., and Clarke Reed, Separaton Corp.

There will be a meeting of the Fibrous Agricultural Residues Committee as usual on Monday afternoon, Feb. 15, 1954, at the Commodore Hotel, New York, N. Y., as part of the general Annual TAPPI Meeting. All members of this committe who plan to attend the Annual Meeting were urged to attend the Monday afternoon sessions.

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Tour of The Hinde and Dauch Strawboard Mill

Mr. Aronovsky then turned the meeting over to Mr. Palm, who proceeded with a description of The Hinde and Dauch Paper Co. mill at Trenton featuring the Va-Purge process. Reprints were distributed of a symposium on the Va-Purge process held by the Technical Section of the Canadian Pulp and Paper Association. Mr. Palm pointed out that further improvements have been made since the time of this publication. The cooking cycle had been reduced and additional 10% improvement in stiffness had been achieved. The Va-Purge process has resulted in improved strawboard quality and in increased production at lower costs. It should serve as an impetus to the long-overdue revitalization of the strawboard industry.

The meeting was concluded with a visit to the strawboard mill at Trenton, where a first-hand inspection of the Va-Purge process was made.

General view of the Hinde & Dauch mill, Trenton, Ont., the first straw mill to use the Va-Purge Process

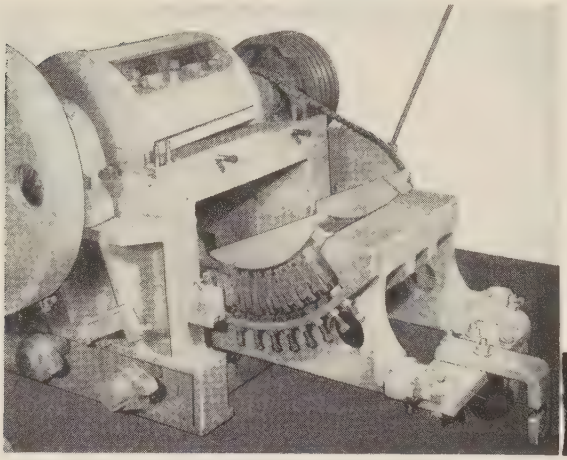
Everyone present agreed that this was one of the most informative meetings held by the Fibrous Agricultural Residues committee. The success of this meeting was due in large part to the generosity of the host company, The Hinde and Dauch Paper Co. of Canada, Ltd., and particularly to the excellent planning and work of Mr. Palm and members of his staff.

Attendance

Aronovsky, S. I., in Charge, Pulp and Paper Section, Agricultural Residues Div., Northern Regional Research Laboratory, Peoria, Ill.

Balough, H. O., Plant Engineer, Mill Div., Hinde and Dauch Paper Co., Sandusky, Ohio
Bamer, B. H., Plant Manager, Stone Container Corp., Coshocton, Ohio
Baron, G. C., Assistant Superintendent, Consolidated Paper Co., Monroe, Mich.
Blandin, H. M., Development Engineer, Consolidated Paper Co., Monroe, Mich.
Bush, V. E., Plant Manager, Hinde and Dauch Paper Co., Fort Madison, Iowa
Carpenter, E. R., Technical Director, Terre Haute Div., Weston Paper & Manufacturing Co., Terre Haute, Ind.
Clark-Riede, J. R., Vice-President Operations, Separaton Corp., Montreal, Que.
Cowhey, T. T., Sales Engineer, Bauer Brothers Co., Springfield, Ohio
Dieckbrader, F. A., General Superintendent, Hinde and Dauch Paper Co. of Canada, Ltd., Toronto, Ont.
Donlop, G. A., Manager, Ohio Straw Co., Coshocton, Ohio
Eberhardt, L., Sales Engineer, Bauer Brothers Co., Springfield, Ohio
Eldridge, R., Superintendent, Terre Haute Div., Weston Paper & Manufacturing Co., Terre Haute, Ind.
Fiori, J. J., Vice-President and General Manager, Stone Container Corp., Coshocton, Ohio
Harbrecht, W. L., Assistant Superintendent of Mills, Hinde and Dauch Paper Co., Sandusky, Ohio
Johnson, D. E., Pulp Research, St. Regis Paper Co., Deferiet, N. Y.
Jones, D., Executive Secretary, Canadian Pulp and Paper Association, Montreal, Que.
Knapp, E., Manager Testing Laboratory, Hinde and Dauch Paper Co., Sandusky, Ohio
Lewis, W. D., Manager, Muskingum Fibre Products Co., Coshocton, Ohio
Little, J. R., Chemical Engineer, Hinde and Dauch Paper Co., Sandusky, Ohio
Macdonald, R. G., Technical Association of the Pulp and Paper Industry, New York, N. Y.
Magruder, R., Sales Engineer, Sprout, Waldron and Co., Inc., Muncy, Pa.
McCarron, R. D., Morningstar, Nicol, Inc., New York, N. Y.
Miterko, F. A., Laboratory Technician Pulp Research, St. Regis Paper Co., Deferiet, N. Y.
Odze, W., Vice-President Operations, Separaton Corp., Montreal, Que.
Ostrowski, H. J., Chief Chemist, Hinde and Dauch Paper Co. of Canada, Ltd., Trenton, Ont.
Owen, D. L., General Superintendent of Mills, Hinde and Dauch Paper Co., Sandusky, Ohio
Palm, W. H., Vice-President Production, Hinde and Dauch Paper Co. of Canada, Ltd., Toronto, Ont.
Strapp, R. K., Assistant Head, Chemical Pulping Group, Pulp and Paper Research Institute of Canada, Montreal, Que.
Thiesmeyer, L. R., President, Pulp and Paper Research Institute of Canada, Montreal, Que.
Wells, S. D., Research Associate, The Institute of Paper Chemistry, Appleton, Wis.
Wilson, J., Assistant Superintendent, Hinde and Dauch Paper Co. of Canada, Ltd., Trenton, Ont.

S. I. Aronovsky, *Chairman*
Fibrous Agricultural Residues Committee



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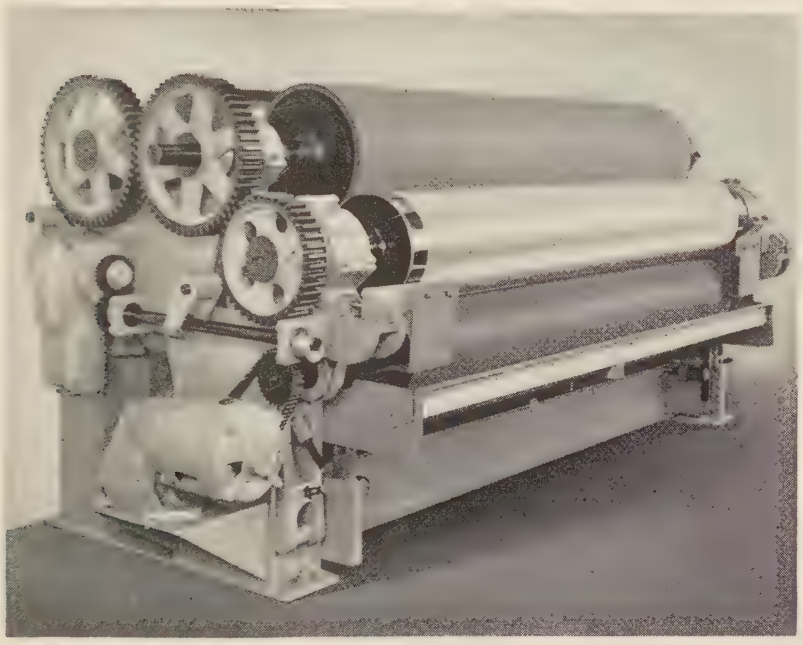

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Ollie Ant-Wuorinen, Professor and Director of Chemical Technical Laboratory, The State Institute for Technical Research, Helsinki, Finland, with a Ph.D. degree from the University of Birmingham and the University of Helsinki.

Eugene A. Barton, Design and Contact Engineer, H. K. Ferguson Co., Cleveland, Ohio, a 1934 graduate of Rutgers University.

Richard B. Bayston, Vice-President in Charge of Sales, Chattanooga Boiler & Tank Co., Chattanooga, Tenn.

Trula Biornstad, General Director, The Kellner-Partington Paper Pulp Co. Ltd., Hallein bei Salzburg, Austria.

Lee F. Chaney, Service Engineer, Flox Company, Inc., Minneapolis, Minn. Attended Denver University.

John S. Cheriton, Control Superintendent, Abitibi Power & Paper Co., Smooth Rock Falls, Ont., Canada, a 1944 graduate of McMaster College.

Norvon Clark, Acting District Contact Manager, The H. K. Ferguson Co., New York, N. Y., a 1938 graduate of the University of Chattanooga.

Jean F. Clerc, Professor, Process Engineering and Consulting Engineer, Winterthur Technical Institute, Winterthur, Switz., a 1917 graduate of the Institute.

Owen M. Cornell, Salesman, American Cyanamid Co., New York, N. Y., a 1922 graduate of Allegheny College.

A. Harvey Crute, Research Chemist, Alaska Pine & Cellulose Co. Ltd., Woodfibre, B. C., Canada, a 1942 graduate of the University of British Columbia.

Herbert S. Currie, Director, Development and Research, Bowater Paper Corp., London, England.

Robert R. Cutler, Sales Manager, Central District, The H. K. Ferguson Co., Cleveland, Ohio, a 1929 graduate of Marietta College, and a 1932 graduate of Chicago University.

Yves de Courlon, Technical Manager, Papeteries d'Arches, Arches (Josges) France, a 1943 graduate of the National School for Mining Industrie.

Warren A. DeVoe, Chemical Engineer, Marathon Corp., Rothschild, Wis., a 1945 graduate of the University of Wisconsin.

Fernand L. Eloy, Technical Manager, Etablissements Raoul Simon, S. A., Brussells, Belgium.

John Eyton, Electrical Engineer, Abitibi Power & Paper Co., Toronto, Ont., Canada.

Louis G. Good, Senior Project Engineer, Panellit, Inc., Chicago, Ill., a 1948 graduate of Virginia Polytechnic Institute.

Ralph C. Hall, Assistant Superintendent, Pulp Mill, Union Bag & Paper Corp., Savannah, Ga.

Metin R. Hamarat, Manager, Union Bag & Paper Corp., Savannah, Ga., a 1942 graduate of Georgia School of Technology.

George S. Hammer, Jr., Quality Control Supervisor, Forbes Lithograph Mfg. Co., Boston, Mass. Attended Northeastern Polytechnic Institute.

Taishiro Hanada, Assistant Superintendent, Sanyo Pulp Co. Ltd., Iwakuni-Shi, Japan, a 1941 graduate of Kyushu University.

Harold S. Hilton, Sales Manager, Northwest Copper Works, Inc., Portland, Ore., a 1944 graduate of the University of Washington.

William H. Hoge, Group Leader of Fundamental Research, Oxford Paper Co., Rumford, Me., a 1954 graduate of The Institute of Paper Chemistry with a Ph.D. degree.

George D. Humphrey, Director, Cellulose Sales, Alaska Pine & Cellulose Ltd., Vancouver, B. C., Canada. Attended Mt. Allison College, McGill University.

Leslie G. Janett, Sales Engineer, J. O. Ross Engineering Corp., Chicago, Ill., a 1935 graduate of the University of Wisconsin.

H. Lawrence Ketcham, Jr., Chemist, E. I. du Pont de Nemours & Co., Inc., Newport, Del., a 1950 graduate of Virginia Polytechnic Institute.

Howard E. Kincer, Chemical Engineer, West Virginia Pulp & Paper Co., Luke, Md., a 1940 graduate of Roanoke College.

Lawrence L. Krasin, Salesman, Marquette Paper Corp., Chicago, Ill., a 1936 graduate of the University of Wisconsin.

Albert J. Krusick, Salesman, Paisley Products, Inc., Cleveland, Ohio.

William E. Larson, Technical Service Engineer, Champion Paper & Fibre Co., Hamilton, Ohio, a 1953 graduate of the New York State College of Forestry.

Thomas Leech, Vice-President and General Manager, Whiting-Plover Paper Co., Stevens Point, Wis., a 1936 graduate of Lawrence College.

H. Elroy Lindberg, Plant Superintendent, Robert Gair Co., Ft. Niagara Corrugated Box Div., N. Tonawanda, N. Y., a 1938 graduate of New York University.

Edwin L. Lovell, Research Manager, Rayonier, Inc., Shelton, Wash., a 1940 graduate of McGill University.

Bernard F. Major, Supervisor, Receiving and Packaging Quality Control, Ortho Pharmaceutical Corp., Raritan, N. J.

Charles H. McCarthy, Technical Superintendent and Coating Dept. Superintendent, Assistant Manager, Consolidated Water Power & Paper Co., Stevens Point, Wis.

C. G. McLaren, Vice-President and General Manager, National Container Corp., Tomahawk, Wis., a 1927 graduate of Iowa State College.

Delbert C. Meyer, Assistant Chief Engineer, The Gardner Board & Carton Co., Middletown, Ohio, a 1931 graduate of Purdue University.

David S. Most, Student, Institute of Paper Chemistry, Appleton, Wis., a 1952 graduate of Boston University.

Francis C. Mudge, Manager, Technical Service Dept., Wheat Industries (Aust) Pty Ltd., Sydney, N.S.W., Australia.

Albert Oetken, Chemical Engineer, International Paper Co., Palmer, N. Y., a 1948 graduate of Rensselaer Polytechnic Institute.

Haruto Okumura, Chief, Investigation Dept., Takachiho Paper Mfg. Co. Ltd., Chuo-ku, Tokyo, Japan, a 1933 graduate of Tokyo Agricultural College.

Herbert S. Pahren, Vice-President, Elliott Co., New York, N. Y., a 1924 graduate of the University of Cincinnati.

Wesley P. Pattison, Laboratory Technician, Schmidt & Ault Paper Co., York, Pa.

Stephen W. Pease, Chemist, General Electric Co., Hudson Falls, N. Y., a 1949 graduate of Pennsylvania State College.

Charles J. Prawdzik, Plant Superintendent, New Haven Container Corp., New Haven, Conn. Attended Rutgers University.

Charles W. Raleigh, Research Chemist, Buffalo Electro-Chemical Co., Buffalo, N. Y., a 1949 graduate of Northeastern University.

E. Gustaf R. Ranhagen, Project Engineer, The Swedish Cellulose Co., Sundsbruk, Sweden, a 1937 graduate of Orebro Hogre Tekniska Laroverk TGO, Orebro, Sweden.

Erik Saxen, Technical Manager, A/B J. W. Enqvist O/Y, Lielahti, Finland, a 1931 graduate of the University of Helsinki.

George E. Schroeder, Chemist, Kelco Co., Chicago, Ill., a 1946 graduate of the University of Chicago.

Francis K. Smith, Chemical Engineer, West Virginia Pulp & Paper Co., Luke, Md., a 1950 graduate of West Virginia University.

Robert C. Stamm, Process Engineer, West Virginia Pulp & Paper Co., New York, N. Y., a 1950 graduate of Columbia University.

Luigi Stangalini, Manager, S. A. Industria Fibre e Cartoni Speciali, Milano, Italy.

Sinclair P. Strayer, Assistant Chief Chemist, Pulp Mill, St. Regis Paper Co., Tacoma, Wash., a 1939 graduate of Harvard University.

Wells N. Thompson, Vice-President, The H. K. Ferguson Co., New York, N. Y., a 1921 graduate of Cornell University.

Warren B. Weber, Technical Associate, Institute of Paper Chemistry, Appleton, Wis., a 1939 graduate of the University of Minnesota.

Jack Weiner, Research Associate and Editor, Institute of Paper Chemistry, Appleton, Wis., a 1932 graduate of the College of the City of New York.

TAPPI Notes

Stanley C. Adams, formerly of Potlatch Forests, Inc., is now in the Packaging Research & Development Laboratories of Western Waxed Paper Div., Crown Zellerbach Corp., San Leandro, Calif.

Oscar E. Anderson, Jr., of the International Paper Co. has been transferred from Palmer, N. Y., to Niagara Falls, N. Y., as a Chemical Engineer.

Paul V. Barrow, formerly of the Federal Container Co., is now with the Eastern Div. of Fibreboard Products, Inc., at 56th and Paschall Ave., Philadelphia, Pa.

Henry E. Becker, formerly Technical Director of Coos Bay Pulp Co., is now with Scott Paper Co., Chester, Pa.

B. B. Blaney is now Factory Representative for Bemis Bro. Bag Co., East Pepperell, Mass., and is located in Kenmore, N. Y.

O. D. Bluthardt, formerly of R. B. H. Dispensers, is now in the Sales Dept. of Wilson Products, Inc., Neshanic, N. J.

O. E. Bryde is now Technical Manager of Vestfos Cellulosefabrik, Vestfossin, Norway.

Clifton P. Boutelle, formerly of the Alliance Paper Mills, is now Administrative Assistant for the Gardner Board & Carton Co., Middletown, Ohio.

George E. Boyhan, formerly of the International Paper Co., is now Project Engineer for Parsons & Whittemore, Inc., New York, N. Y.

Kenneth G. Chesley is now in the Research Div. of the Crossett Co., Crossett, Ark.

Neil H. Christian is now General Superintendent of the Nekoosa-Edwards Paper Co., Port Edwards, Wis.

Ralph M. Cook, Jr., formerly of the Claremont Paper Co., is now a student of the Bangor Theological Seminary, Bangor, Me.

William J. Copeland of the International Paper Co. has been transferred to the Sales Dept. of the company in New York City.

Percy J. Cox, formerly of Driscoll's Standard Coatings, Inc., is now a Chemical Engineer for the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

C. Crispin of MacMillan & Bloedel, Ltd. has been transferred from Namino, B. C., to Vancouver, B. C.

John E. Dain of the Cameron Machine Co. has been transferred to Decatur, Ga., as Sales Manager of the Southern Div.

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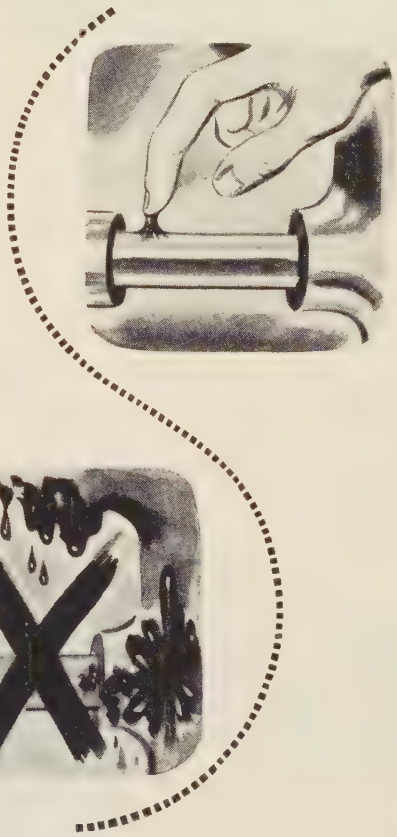

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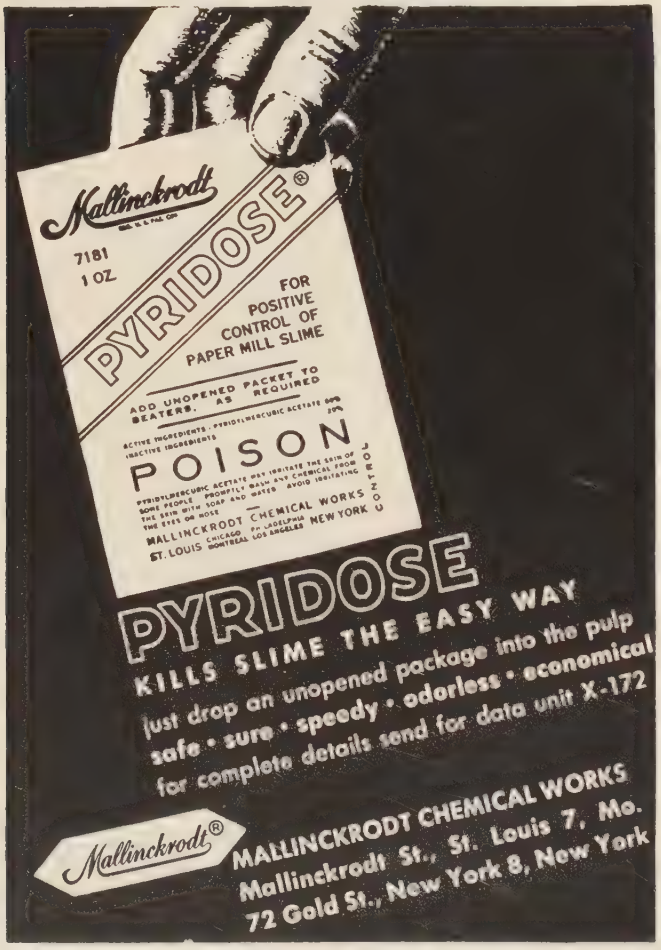
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William H. De Montmorency is now Chief, Mill and Shops Group and Mechanical Pulping Group of the Pulp and Paper Research Institute of Canada, Montreal, P. Q.

James Dillin, formerly of Industria, Inc., is now in the Sales Dept. of the U. S. Machinery Co., New York, N. Y.

A. W. Duskin is now Assistant Paper Mill Superintendent for the Crossett Corp., Crossett, Ark.

August S. Erspamer, formerly General Superintendent of the St. Helens Pulp & Paper Co., is now with Hollingsworth & Whitney Co., Waterville, Me.

George A. Farrah, Assistant to the Vice-President of the National Container Corp. of Wisconsin, has been transferred from Tomahawk, Wis., to Milwaukee, Wis.

John E. Franklin, formerly of Bowater's Newfoundland Pulp and Paper Mills, has been transferred from Corner Brook, Newfoundland, to the Central Research Laboratories of Bowater's Development and Research Ltd., Northfleet, near Gravesend, Kent, England.

Robert L. Fraser, formerly of Abitibi Power & Paper Co., Toronto, is now Mill Manager of the Manitoba Paper Co. Ltd., Pine Falls, Man.

Alfred T. Gardner, formerly of Provincial Paper Ltd., is now Paper Mill Consultant for the Champion Paper & Fibre Co., Pasadena, Tex.

Robert W. Gassin, formerly with Century Metalcraft Corp., is now an Engineer for J. E. Sirrine Co., Greenville, S. C.

Paul M. Goodloe of the Technical Service Dept. of Brown Co., has been transferred from New York, N. Y., to Berlin, N. H.

Julius Grant is now Managing Director of Henner & Cox Ltd., London, England.

Richard H. Hammond, formerly of the Weyerhaeuser Timber Co., is now a Research Consultant in Longview, Wash.

Richard Herrlinger, formerly of the Arizona Chemical Co., is now in the Research Div. of the American Cyanamid Co. Stamford, Conn.

Hans Hess, formerly of Papierfabrik Biberist, is now Superintendent of Papierfabrik Utzenstorf, Utzenstorf, Switzerland.

Paul Hilger is now Vice-President of Joseph Eck & Son Dusseldorf, Germany.

Maurice L. Hobday, formerly of the Imperial Paper Mills Ltd., is now General Manager of the Tasman Pulp & Paper Co., Auckland, N. Z.

Charles W. Hoffman is now Assistant Manager of Converted Glassine Sales for the Riegel Paper Corp., New York, N. Y.

Harry B. Hulse, formerly of Robert Gair Co., is now Quality Control Manager for The Upson Co., Lockport, N. Y.

E. Norval Hunter, Vice-President of The KVP Co. Ltd., has transferred his office from Espanola, Ont., to Toronto, Ont.

Vernon Iverson is now Technical Control Supervisor for the Nekoosa-Edwards Paper Co., Port Edwards, Wis.

Wilfred E. Johnson, Chemical Engineer for the Union Bag & Paper Co., has been transferred from Savannah, Ga., to New York, N. Y.

J. M. Jopp is now Assistant to the President—Engineering, Brown Corp., La Tuque, P. Q.

Frederick C. Keeney is now Chief Chemist of the Sulphite Mill of Weyerhaeuser Timber Co., Everett, Wash.

Charles A. Kemp, formerly of the International Paper Co., is now Methods Analyst for Kimberly-Clark Corp., Kimberly, Wis.

W. Oliver Kincannon, Jr., Technical Service Engineer for the Hercules Powder Co., has been transferred from Milwaukee, Wis., to Wilmington, Del.

Mildred Kocic, formerly of Hollingsworth & Whitney Co., is now Assistant Chemist for the International Paper Co., Niagara Falls, N. Y.

F. Kraft is now Technical Assistant to the Executive Vice-President of Marathon Corp., Menasha, Wis.

H. Hanson Lagerpusch, formerly with Penick & Ford Ltd.,

is now an Engineer-Chemist for the Union Starch Co., Columbus, Ind.

Maurice J. Landberge is now Manager of the Paper Dept., General Dyestuff Corp., New York, N. Y.

Rutgar Larson, formerly of A/B Stjernfors, is now with A/B Klipparns Furpappersbruk, Klippan, Sweden.

Elisha B. Lewis, formerly of the University of Chattanooga, is now with Behr-Manning Corp., Troy, N. Y.

Rudolf A. Maronne, formerly of French Indo-China, is now Manager of the Foreign Div. of Escher Wyso Machine Co., Ravenburg, Wurtenburg, Germany.

George E. Martin is now Chief Chemist for Fibreboard Products, Inc., Antioch, Calif.

Thomas F. Martin, Jr., formerly of the Container Corp. of America, is now Technical Director of the Hartford City Paper Co., Hartford City, Ind.

Paul E. McCoy is now Chief Chemist for American Bitumuls & Asphalt Co., San Francisco, Calif.

W. R. McKelvy, formerly of Hazelhurst Mills, is now with the Fulton Bag & Cotton Mills, Atlanta, Ga.

Ernest A. G. McLean, formerly of MacMillan & Bloedel, is now Control Engineer for the Manitoba Paper Co., Pine Falls, Man.

Julio Molleda, formerly student at the New York State College of Forestry, is now a Project Engineer for the Comision Gestora de la Celulosa, Institute Nacional de Industria, Madrid, Spain.

A. E. Montgomery has retired as Vice-President of J. O. Ross Engineering Co., Chicago, Ill.

Charles A. Newman is now General Superintendent of the Quebec North Shore Paper Co., Bail Comeau, P. Q.

Ralph M. Newman, Jr., formerly of Pusey & Jones Corp. is now with the Elk Paper Co., Childs, Md.

Edward K. Nissen is now Development Supervisor of the Nekoosa-Edwards Paper Co., Port Edwards, Wis.

Wilbur R. Noel has returned from the Army to his former position as Chemist for the Kalamazoo Paper Co., Kalamazoo, Mich.

Leslie A. Palmer is now Vice-President and Mill Manager of the Donnacona Paper Co., Donnacona, P. Q.

Elvin G. Powell, formerly with the National Biscuit Co., is now Quality Methods Specialist for the Marathon Corp., Menasha, Wis.

Richard A. Premo is now Assistant Production Manager of the Gould Paper Co., Lyons Falls, N. Y.

Ralph N. Prince, formerly of J. & J. Rogers Co., is now Technical Service Representative of Eastern Chemicals, Inc., Rensselaer, N. Y.

Lloyd T. Sandborn is now Assistant Director of Research for the Crossett Co., Crossett, Ark.

Lennart Schauman, formerly of McEwen Bros., is now Manager of the Mill Div., Gair Co. of Canada, Ltd. Toronto.

E. H. Smith is now Technical Service Director of the Crossett Co., Crossett, Ark.

Clark E. Snook, formerly Chief Paper Chemist, is now a Salesman serving the Virginia and Maryland territory of Napco Chemical Co., Harrison, N. J.

R. A. Stone, formerly of Rayonier, Inc., is now Engineer for the Kennecott Copper Co., Sorel, P. Q.

Arnold R. Sundhohn is now Technical Manager of Amotfors Pappersbruk A/B, Amotfors, Sweden.

Charles S. Sweetzer is now Technical Supervisor of Mill No. 1., Gardner Board & Carton Co., Middletown, Ohio.

Harold S. Vanderhei, formerly of the Combined Locks Paper Co., is now Vice-President in Charge of Manufacture for the D. M. Bare Paper Co., Roaring Springs, Pa.

O. J. Walker, formerly Research Chemist for the Northeastern Paper Products Co., is now with the Anglo-Canadian Pulp & Paper Mills, Ltd., Quebec, P. Q.

Bruce L. Wally, formerly student at the New York State College of Forestry, is now a private, K. Co., 4th Plt., 364th Infantry Regiment, Fort Dix, N. J.

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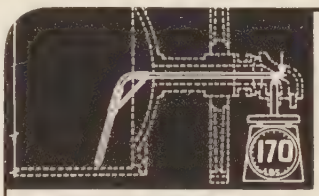

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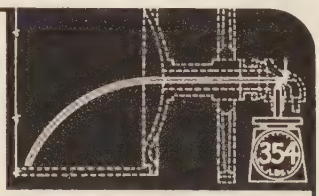

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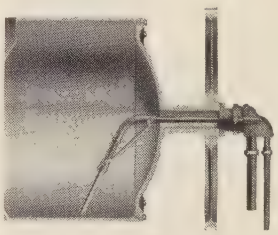

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Wally Z. Walters, formerly student at the University of Cincinnati, is now a student at The Institute of Paper Chemistry, Appleton, Wis.

John T. Ward, Chief Chemist for the Riegel Paper Corp., has been transferred from Milford N. J., to New York, N. Y., as a Sales Engineer.

Charles Weidman of the Ciba Co. has been transferred from Montreal P. Q., to New York, N. Y., as Technical Director.

Robert R. Young of the Pollock Paper Corp. has been transferred from Circleville, Ohio, to Columbus, Ohio, as Assistant to the Superintendent.

Thomas G. Zentner of the Gardner Board & Carton Co. has been transferred from Middletown, Ohio, to Lockland, Ohio, as technical supervisor.

* * *

Morris Wayman, Technical Director, has succeeded *M. E. Martin* as the official corporate representative of the Columbia Cellulose Co. Ltd. in the Technical Association.

Fred Kruse has succeeded *John S. Brush,* General Manager, as the official corporate representative of the Gould Paper Co. in the Technical Association.

Charles J. Plopper, Chemist, has succeeded *Myron W. Black* (deceased) as the official corporate representative of the Inland Empire Paper Co. in TAPPI.

The name of the New Haven Pulp & Board Co., New Haven Conn., a TAPPI corporate member, has been changed to the New Haven Board & Carton Co.

Howard H. Street has succeeded *John Macadam* as the official corporate representative of the National Vulcanizer Fiber Co., Wilmington, Del., in the Technical Association.

* * *

F. A. C. Wandurburg has succeeded *O. F. Lane* as the official representative of the Pigments Div. of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., in the Technical Association.

The General American Transportation Co. has moved its New York City offices from 10 E. 49th St. to 380 Madison Ave.

Carl Brink has succeeded *George A. Hermann* as the official representative of The Hermann Manufacturing Co., Lancaster, Ohio, in TAPPI.

John C. Pennock has succeeded *A. L. Burton* as the official representative in TAPPI of Tracerlab, Inc., Boston, Mass.

C. P. Walker has succeeded *A. M. Cooper* as the official TAPPI representative of the Westinghouse Electric Corp., East Pittsburgh, Pa.

Industry Notes

Production

Paper and board production during September amounted to 2,232,933 tons according to the Bureau of the Census, Dept. of Commerce. This is about a 10% increase over the tonnage of 2,027,431 produced in September a year ago. The output of paperboard grades during this month, amounting to 1,049,280 tons, reflected an increase of 13% over the production of 928,797 tons reported during September, 1952. Paper production, amounting to 938,875 tons registered an 11% increase from the 845,449 tons produced in September a year ago.

Pulpwood receipts at the pulp mills during September amounted to 2,494,182 cords, with consumption at 2,305,823 cords. Month-end inventories increased about 4% to 5,627,519 cords.

Receipts of fibrous materials, other than wood pulp, totaled 813,783 tons. Consumption at 855,890 tons was greater than receipts, and inventories dropped 5% to 850,673 at month's end. Receipts of wastepaper at 733,328 tons were below consumption which amounted to 748,456 tons. End of month inventories of wastepaper, at the mills, accordingl dropped 3% to 428,532 tons.

Wood pulp production, during September amounted t 1,420,070 tons as compared to 1,315,168 tons produced i September a year ago.

Wood pulp inventories at the end of September at th paper and board mills amounted to 517,752 tons, showing small decline during the month. Month-end stocks at th pulp mills were 147,121 tons, 7% under the 158,827 tons re ported at the end of August.

Production of Paper and Board, Nine Months of 1953 and Relationship to Production During Nine Months of 195 and 1952

	Production, nine months 1953	*Per cent change from nine months* 1952	1951
Group A—Printing and similar papers	2,678,345	+ 5.9	+ 2.
B—Fine papers	948,125	− 4.2	− 5.
C—Coarse papers	2,546,594	+ 4.5	− 4.
D—Tissue papers	1,105,197	+10.7	− 1.
E—Miscellaneous papers	401,664	+ 4.4	− 0.
F—Total, groups A to E	7,679,925	+ 4.6	− 1.
Newsprint	789,679	− 5.9	− 4.
Building paper	1,004,860	+ 3.4	− 8.
Total paper	9,474,464	+ 3.5	− 2.
Paperboard	9,342,738	+18.3	+ 1.
Building board	1,083,465	+12.2	+10.
Total board	10,426,203	+17.7	+ 2.
Grand Total	19,900,667	+10.5	− 0.

Pulpwood

At the end of August, total receipts of pulpwood for 195 amounted to 18,227,000 cords, about 100,000 cords, less tha receipts for the same period in 1952. Receipts of domest wood increased by approximately 536,000 cords, while import decreased by about 637,000 cords. The Appalachian, Sout ern, and Pacific regions showed increases in receipts rangi from 4 to 12% while in the Northeast and Lake States region receipts decreased by 27 and 23%, respectively.

Consumption continued high, raising consumption for th year through August to 18,713,000 cords, an increase of 1,087, 000 cords over 1952 for the comparative months. The only decrease in consumption occurred in the Northeast where a decrease of 6% was reported. In the other four regions, in creases ranged from 4 to 11%.

Inventories at the end of August of 5,423,000 cords were an increase of 231,000 cords over the previous month, but 334,000 cords less than inventories at the end of August last year In comparison to inventories at the end of August last year the Southern and Pacific regions showed increases of 18 and 9%, respectively, while the other three regions showed de creases ranging from 8 to 19%.

Wood Pulp

Production of wood pulp in August reached a record high of 1,530,000 tons, and for the January–August period this year, totaled 11,672,000 tons, an increase of 730,000 tons over the comparable period in 1952.

Consumption likewise reached a record monthly high o 1,609,000 tons. Consumption for 1953 through August amounted to 12,424,000 tons, an increase of 989,000 tons above the like months last year.

Wood pulps imports in August were still high, raising im ports for 1953 through August up to 1,441,817 tons, an in crease of 257,520 tons over the comparable months last year Imports from Canada increased by 20,775 tons, and from Europe by 236,745 tons.

Exports continued to be moderate in August, and for the first 8 months of this year were 89,000 tons, a decline of 77,000 tons under 1952 for the same period.

Inventories of wood pulp at the end of August were 683,000 tons, approximately 2500 tons less than at the end of July, but still 13,000 tons above inventories at the end of August last year. Inventories at pulp mills at the end of August were 159,000 tons and at paper and board mills 524,000 tons.

Wastepaper

Wastepaper consumption in November in the East, and throughout the entire country for that matter, substantially exceeded the consumption of November, 1952, which was the second highest consumption month of that year. Among the Eastern mills, November consumption was up about 9% over November, 1952, and purchases up about 12%. Consumption in the East was 30% above that of November, 1951, and purchases were 28% higher.

In round figures, the wastepaper consuming mills of the East in the first 46 weeks of 1953 purchased and consumed substantially over 100,000 tons more of paperstock than during the entire year of 1952. In both purchases and consumption the Eastern mills likewise are running ahead of 1950. It is still uncertain whether the all-time high of 1951 will be attained, but it seems now that both consumption and mill receipts may fall short of that pinnacle by a few thousand, or perhaps hundreds of tons.

Forest Ownership

Secretary of Agriculture Benson has stated that the Administration opposed increasing the total area of national forests. He added, however, that there was "a continuing need for exchange of lands to block out public and adjacent private holdings and thereby aid in more efficient management."

Secretary of Interior McKay has declared that the Government's main objective in its public land policy would continue to be "the gradual return of the public domain to private ownership."

Directors of the American Forestry Association have recommended the creation of a joint Senate-House Committee to consider a desirable pattern for ownership of national, state, and private forest land and other conservation lands, and to formulate policies to guide the actions of public agencies.

Community Dependency

The study recently completed by the American Paper and Pulp Association brings out many interesting facts of the dependency of a large number of communities on the pulp and paper industry. For example, the industry is located in 488 communities of which about one third or 159 communities are more than 50% dependent upon the industry—85 being 100% dependent. One hundred eighty-four establishments (27% of the total) located in these 159 communities employ about half the total number of workers in the industry, 91 establishments being located in communities 100% dependent.

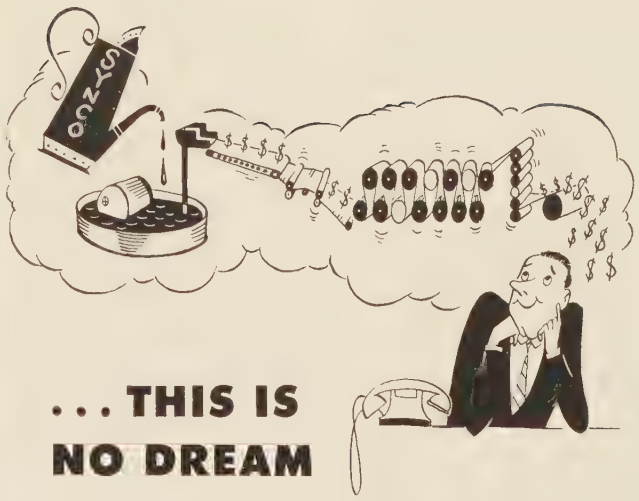
In relation to size of community, 356 establishments (54% of the total) employing 120,427 workers (45% of the total) are located in 299 communities having a population of 10,000 or less.

Wisconsin ranks as the number one state in number of workers, though New York is only fractionally behind. New York has the largest number of communities with paper/pulp mills, 77, with Massachusetts ranking second with 38.

Copies of this study are available upon request from the American Paper and Pulp Association, 122 E. 42nd St., New York, N. Y.

Wood Pulp—A Review and a Reappraisal

Twenty years ago the fortunes of North American pulp and paper producers were at their lowest historical ebb. By



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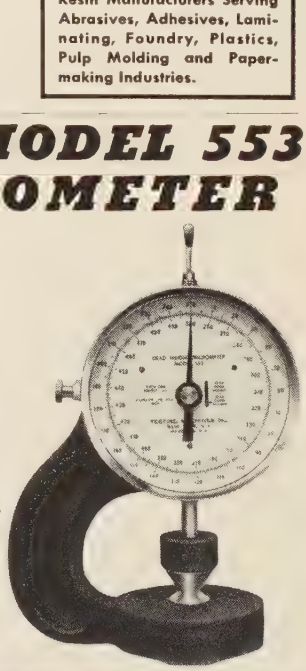

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contrast, although there have been many emergencies during the past 20 years, today the prospect is bright. All the signs indicate a welcome degree of future economic stability of the North American wood pulp industry and of all pulp-dependent industries on this continent.

Basic relationships in the world's pulp and paper economy have completely altered the position of North America in this economy, and standards of judgment that have traditionally been used to appraise the outlook for pulp and paper products are no longer applicable.

North America's interest in world fiber markets has become a majority instead of a minority interest. Prewar, this continent's production of wood pulp was substantially less than Europe's; currently, it is $2^1/_2$ times European production. Reliance on Europe for basic fiber needs in the past has resulted in excessive inventory cycles, and these cycles in turn have been largely responsible for the erratic behavior of markets, prices, and profits in the North American pulp and paper economy. Currently, North America is not only independent of overseas fiber supply sources, but has export surpluses that should, in the next decade, reach very substantial proportions.

Furthermore, fiber demand in North America is currently far larger, far more diversified, and far more soundly based than it has ever been in the past.

There have been revolutionary changes, not only in the relative importance of traditional sources of fiber supply, but also in the character of world pulp, paper, and paperboard markets.

To understand how these changes have come about and what they mean requires an examination of

1. The economic background.
2. Changes in the pattern of world total wood pulp supply.
3. Changes in the pattern of total wood pulp demand in
   (a) The United States market.
   (b) Old World markets.
4. Changes in the pattern of World market wood pulp supply.
5. Changes in the pattern of World market wood pulp demand.
6. Changes in the pattern of international trade in wood pulp.

Economic Background

Capacity for the production of pulp and paper had expanded rapidly, both in Europe and North America, during the 1920's. Largely because of this temporarily excessive expansion, the pulp and paper industries of the world enjoyed a more or less profitless prosperity in the late twenties. In 1928 and 1929, when markets in general were booming, market imbalances in wood pulp and weaknesses in the pulp and paper price structure were already apparent.

Then came the depression of the early 1930's. The collapse of pulp and paper markets, following so closely the expansion of the world's pulp and paper economy during the 1920's created serious financial problems for pulp and paper producers throughout the world.

Mortality rates were particularly high in the domestic industry for domestic pulp and paper markets generally fared relatively worse than overseas pulp and paper markets in the big depression, and the domestic pulp and paper industry relatively worse than many of the major basic American industries, despite the fact that its rate of earnings, even at the bottom of the depression, never fell below the average for "all manufacturing industries."

Partially responsible for the relatively unfavorable financial record of the domestic pulp and paper industry in the last depression was this country's traditional reliance upon overseas supply sources for a large proportion of its basic fiber requirements. Almost one fourth of the total pulp consumed annually in this country at that time was of overseas origin, and over 60% of the total volume of pulp offered for sale in the United States market came from Europe. Not only this Europe was also the major supplier for the rest of the world.

Imports of overseas pulp were sold in the American market during the depression years at prices well below the domestic cost of manufacture. A 34% devaluation of the Swedish Krona was typical of the devices used 20 years ago to open a lean market to overseas wood pulp. Brutal competition in domestic pulp markets set the spark for cut-throat competition in paper, paperboard, and other end-product markets. Dozens of marginal paper and board mills, bankrupted by the depression, were sold at a mere fraction of their normal value. These mills, after reorganization, had the lowest "overhead" costs in the industry; and, with overseas pulp selling at less than the cost of domestic manufacture, they enjoyed as well the lowest raw material costs. Thus, ironically, mills that had normally been considered marginal set a disastrous competitive pace for end-product markets during the later stages of the last depression. Operating efficiency alone frequently could not close this gap in costs, and an anomalous situation existed as efficient paper mills bowed out in competition with relatively less efficient mills that had been through the wringer of bankruptcy.

Toward the end of the depression, however, there began in the domestic pulp and paper industry a period of intensive market research, product research, and market development. The industry's earlier growth had been predominantly in the field of papers for printing and publishing. Major emphasis in the postdepression period was in other fields of use—primarily in paper and board for packaging, for building, and for sanitation purposes, and in pulps for rayon, cellophane, and other chemical conversion products. A new expansion cycle began in anticipation of widening markets in these new fields of use. By 1935, the domestic pulp and paper industry had recovered its lost equilibrium, and by 1937 improved demand and improved operating rates were setting the stage for reasonable profitability. A downward swing of the inventory cycle interrupted progress temporarily in 1938, and then, in 1939, came the start of World War II.

To consumers of market pulp the world over, it immediately became apparent that, for the duration of the war period, Europe would be an undependable supply source for pulp and pulp products. As long as the channels of distribution remained open, market pulp flowed from Europe in exceptionally heavy volume, as consumers strove desperately to build stock piles as a hedge against the possibility of economic blockade. By the end of 1941, their fears were confirmed for most of the major channels of distribution for European pulp were virtually closed.

For about a year after Pearl Harbor, the accumulated stocks of pulp and pulp products were of such magnitude as to depress end-product sales, prices, and profits at a time when the over-all economy was enjoying a wartime boom. As the Defense Program got into full swing, however, domestic demands for pulp and paper for essential wartime uses rose sharply. At the same time, fiber supply declined sharply, as excessive inventories in the channels of distribution were liquidated, and as the effects of the stoppage of overseas imports began to be felt. When our wartime Allies, who had historically relied heavily upon blockaded Scandinavia for a major portion of their pulp requirements, turned to North America for replacements, the imbalance of supply and demand became desperate, and stringent controls of the North American pulp and paper economy were instituted by the government to insure the success of the war effort.

The experiences of World War II taught this country, in no uncertain terms, that continued dependence upon overseas supply sources for its basic fiber requirements can never be consistent with the objective of National Security. This lesson was underlined and re-emphasized during the Korean War when controls were reinstituted to remedy the situation

created when foreign suppliers diverted an important quantity of fiber from the American market to more profitable markets elsewhere.

Thus, the history of the domestic pulp and paper economy during the past 20 years has been one of successive emergencies, due at least in part, to the traditional reliance upon overseas supply sources for basic fiber requirements. Reliance upon foreign supply sources has set in motion excessive inventory cycles that have proved costly to domestic producers and consumers alike; it has contributed to the deflation of capital values in the pulp and paper industry during periods of depression and to the inflation of these capital values during "boom" periods.

It is against this economic background that the significance of recent developments in the world's pulp and paper economy must be reviewed and judged.

The changes in basic relationships that have occurred in the world's wood pulp economy since 1937, have put an abrupt, end to North America's dependence upon overseas fiber supply sources, indicated the probable course of development of future world markets for pulp and paper, and set the stage for North America's new role in world competition. In addition the changing pattern of world supply and demand, described below, should have the effect of furthering the long-range economic stability of the North American wood pulp industry and of all pulp-dependent industries on the North American continent.

Changes in the Pattern of World Total Wood Pulp Supply

Changes in the pattern of world supply, in the case of chemical wood pulp, the area of supply in which world competition has always been most severe in the past, have been as follows:

Chemical Wood Pulp Production

	1937		1951		
	000's of short tons	*% of world supply*	*000's of short tons*	*% of world supply*	*1951 as a % of 1937*
North America	6,734	43	16,905	66	251
Scandinavia	5,317	34	4,966	19	93
All others	3,626	23	4,003	15	110
Total world	15,677	100	25,874	100	165

Only in North America has there been any significant growth of wood pulp supply since 1937. Postwar pulp production in the rest of the world has been consistently below prewar levels. Nor is there any prospect that these recent trends will soon be altered. North America, fortunately, has both the economic resources and the wood resources to permit expansion; the rest of the world does not. Technological progress in the fields of forest management, the utilization of hardwoods, and the recovery of wood previously regarded as waste, will preserve and expand our available wood resources.

Progress in the utilization of bagasse, reeds, straw, and other fibrous materials, all of which have provided potential competition for wood pulp for a hundred years, is unlikely to advance soon, if ever, to the point where these materials can challenge wood pulp as a basic processing material for fiber-dependent industries. It is true that the softwood forests of Russia and the hardwood forests of tropical countries represent a large possible supply of wood pulp for the future but, for economic, political, or technical reasons, such a development is likely to be slow and at this time cannot be forecast with any accuracy.

Meanwhile, productive capacity in North America continues to expand. Total wood pulp capacity in the United States, by early 1955, will exceed 1952 capacity by 13½%, 1946 capacity by 75%, and 1937 capacity by 163%. Canadian capacity, by early 1955, will exceed her peak postwar production by 12½% and her peak prewar production by 91%.

There are those who profess to see a marked similarity between the current expansion cycle in North America and the expansion cycle of the 1920's. They complain that the industry has failed to learn from the depression of the early 1930's the obvious lesson of cause and effect—namely, that excessive expansion during a period of "artificial boom" can only serve to aggravate the inevitable "bust."

There is certainly no denying the fact that North America's expansion program has been substantial, and that if we are unfortunate enough to encounter another general depression, operating rates and profits in this industry will suffer more than would be the case had this expansion not occurred. This is a contingency, however, that will also face all basic industries that may have undertaken similar expansions.

There are sound reasons for believing, however, that the current expansion program of the North American pulp and paper industry is much more soundly based than past expansions, and that, because of changes in the character of the world's pulp and paper economy, the North American pulp and paper industry will fare at least as well in the next depression, if and when it comes, as other basic American industries. Actually, the scope and pattern of the development of domestic end-product markets in recent years has been such that the North American pulp and paper industry, in the next downward swing of the economic cycle, could fare much better than most basic American industries.

Changes in the Pattern of Total Wood Pulp Demand in the United States Market

Before considering recent changes in the pattern of consumption in domestic pulp markets, however, it might be well to view in proper perspective comparative over-all growth trends in North American markets as compared with growth trends in other world markets:

Chemical Wood Pulp Demand

	1937		1951		
	000's of short tons	*% of world demand*	*000's of short tons*	*% of world demand*	*1951 as a % of 1937*
North America	7,861	50	16,853	66.5	214
Scandinavia	1,230	8	1,764	7.0	143
All other	6,586	42	6,720	26.5	102
Total world	15,677	100	25,337	100.0	161

The explanation of this shift in demand lies in the significant changes in the pattern of United States consumption that have occurred since 1937. Outlets for wood pulp in the United States are currently far broader in scope and far more diversified in character than they were 15 or 20 years ago. The marked trend toward end-product diversification and the spectacular growth of new uses that were relatively minor 20 years ago, more than anything else explains and justifies the recent growth of fiber demand in United States markets.

The following table shows the nature and extent of the revolution that has occurred in the domestic production of paper and paperboard, the major outlets for wood pulp:

Changes in the Pattern of U. S. Paper and Paperboard Production

	1937		1951		
	000's of short tons	*% of total production*	*000's of short tons*	*% of total production*	*1951 as a % of 1937*
Printing and writing	3,783	29.5	5,989	23.0	158
Packaging	7,370	57.4	14,308	54.9	194
Building	726	5.6	2,655	10.2	366
Sanitary and other	958	7.5	3,096	11.9	323
Total	12,837	100.0	26,048	100.0	203

Thus, the fastest growing outlets for wood pulp in the domestic pulp and paper industry have been those that consume paper and paperboard for packaging, building, or sanitary uses. The recent expansion of the North American wood pulp industry has been designed primarily to meet requirements in these fast-growing segments of use.

Several factors have contributed to the recent spectacular growth of paper consumption for packaging, building, and sanitary purposes. Most important, perhaps, has been the vertical integration of ownership of productive facilities in these particular fields. This has led to improved productivity, to lower over-all production costs, and most important to an intensive concentration of sales effort on end products rather than intermediate products in the channels of distribution, with continual emphasis on the development and promotion of new products.

A second factor is that the sales appeal of these products has been largely based upon the fact that each, in its own way, serves to reduce excessive labor costs in its specific field of use—packaging papers and boards by their contributions to self-service marketing, building papers and boards by their labor-saving appeal in the construction field, sanitary papers by their convenience and savings in homes, factories, restaurants, hospitals, etc.

It is significant, too, that all of the major end uses of paper and paperboard are basically utilitarian. For this reason, future demand for paper and paperboard products should be less vulnerable to the vagaries of the market place than the demand for products less vital to the maintenance of basic living standards. Paper and paperboard, in their major areas of use, are singularly functional and singularly economical, and the industry should, therefore, be well able to hold its own against the inroads of other competing materials.

There has been a similar spectacular growth in the demand for dissolving wood pulp in new fiber-based chemical conversion industries—i.e., rayon and acetate, cellophane, plastics, photographic film, military and civilian explosives, etc. To help meet this demand, the production of dissolving pulp in the United States has doubled since 1937. New products and carefully planned promotion programs are being developed to expand the chemical conversion outlets for North American dissolving wood pulp. In anticipation of still further increases in world demand, United States capacity for the production of dissolving pulp will again double between 1952 and 1955.

So revolutionary has been the change in domestic outlets for wood pulp that more than one tenth of the wealth generated annually by the entire industrial economy of the United States is now based on the production and conversion of wood pulp and its products. Since economic values pyramid as wood pulp moves successively through various stages of conversion and use, the economic future of America and of her fiber-dependent industries are inseparably linked.

Thus, while the current expansion program of the North American pulp and paper industry bears superficial resemblances to the expansion of the 1920's, there is every reason to believe that, because of greater diversification of end-product markets, the current expansion cycle will prove to be much more soundly based. With ever-increasing emphasis on product research, market research, and sales promotion, the long-range outlook is certainly for a continuing upward movement in the demand for pulp and pulp products.

Changes in the Pattern of Total Wood Pulp Demand in Old World Markets

Another new consideration affecting the outlook for fiber is the relative dormancy of old world markets, and the opportunities that these dormant Old World regions present for future market development.

While demand for chemical wood pulp in North America in 1951 was 214% of 1937 demand and in Scandinavia 143%, demand in the rest of the world was equal to only 102% of its 1937 demand rate. Only in 1951 has Old World demand equaled the 1937 rate. As a result of these contrasting trends, the relative importance of Old World markets in the world's pulp and paper economy has been steadily shrinking.

On a per capita basis, the contrast in the relative importance of world markets for pulp products is even more pronounced, as the following estimates of per capita paper consumption indicate:

Apparent Consumption of Paper and Paperboard (1950)

	Pounds per capita
United States	382.5
Great Britain	133.3
France	63.2
Italy	26.5
Japan	22.7
Brazil	11.7
India	1.3

Economic distress caused in part at least by World War II and shortages of basic wood supplies, more than anything else, have been responsible for retarding the development of Old World pulp and paper markets. To assume that Old World markets will continue dormant, however, is to take an extremely pessimistic view of the outlook for world progress. A more reasonable assumption would seem to be that, with the development of Old World markets for new pulp products, the growth of Old World populations, and the revival of Old World economies, demand for fiber in the rest of the World will eventually rise sharply above current depressed levels.

Certainly to the extent that old world markets expand and diversify their markets for paper and other pulp products, their basic fiber requirements will grow. The following table comparing the changes in the pattern of paper and paperboard production in the two major consuming countries, Great Britain, and the United States, will serve to emphasize the opportunities for market development that exist in Old World countries:

1952 as a Per Cent of Prewar

	United States, %	*Great Britain, %*
Printing and writing	153	74
Packaging	175	107
Building	359	123
Sanitation and other	324	118
Total	190	89

A substantial long-range growth in the Old World's requirements of pulp and pulp products is anticipated. Based on current supply trends, North America will be equipped to supply a substantial portion of these Old World needs. North America's export surpluses will continue to grow as new productive facilities are completed and there is every indication that overseas consumers will need a stable and dependable North American supply source.

Changes in the Pattern of World Market Wood Pulp Supply

The pattern of production of market wood pulp (i.e. pulp produced for sale in world markets) has also changed significantly in the past 15 or 20 years. The next decade will witness even more drastic changes in this particular segment of the World's pulp and paper economy.

Approximately 95% of the total volume of pulp offered for sale in world markets is produced either in North America or Northern Europe (Sweden, Finland, and Norway). Comparative data showing recent changes in the relative importance of these major supply sources are shown below:

Market Wood Pulp Production

	1937		1952		1952 as a % of 1937
	Tons	Per cent	Tons	Per cent	
North America	1978	26.6	3376	45.6	170.6
Northern Europe	5466	73.4	4035	54.4	74.0
Total	7444	100.0	7411	100.0	99.6

It is apparent from the above table that the total volume of pulp produced for sale in world markets has remained virtually unchanged in the past 15 years, but that the relative importance of the two major supply sources has changed significantly.

The tendency in both of these major producing regions has been to convert relatively more of their total pulp production to paper and paperboard in integrated plants, and to offer relatively less for sale to independent paper and paperboard mills. The extent to which this trend toward integration has affected world market pulp supply is indicated in the following comparative figures showing market pulp production as a per cent of total pulp production in the two major producing regions during 1937 and 1952:

	1937	1952
North America	17%	13%
Northern Europe	72%	61%

Indications are that the trend toward integration of productive facilities will continue in Scandinavia and since wood shortages militate against any significant increase in Scandinavia's total pulp capacity, further integration can only serve to reduce further the importance of Scandinavia as a future source of supply for market wood pulp.

North America, in contrast, is currently undertaking a significant expansion of its facilities for the production of market pulp. During the next few years, the rate of increase in North America's market pulp capacity will exceed the rate of increase in capacity for the production of "own use" pulp.

There is every prospect, therefore, that within a very few years North America's market pulp production will materially exceed Scandinavia's, and that the rest of the world, more and more, will look to North America for essential fiber requirements.

Changes in the Pattern of World Market Wood Pulp Demand

There have also been important changes in the relative importance of world markets for wood pulp, and in the pattern of distribution of the world's market pulp supply.

With a few notable exceptions, the major consuming countries of the Old World, because they lack the wood resources to support integrated industries of their own, rely primarily upon imports of market pulp for their basic fiber requirements. In this important respect, these Old World economies differ from the economy of the United States, where market pulp consumption currently represents only 13% of total wood pulp consumption.

This basic difference in the character of the world's pulp and paper economies is bound to affect the scope and pattern of market pulp demand in the future.

In the United States, for example, demand for market wood pulp for paper and paperboard production has been relatively stable for the past 15 years. United States demand for market pulp for the production of rayon, cellophane, plastics, film, explosives, and other new fiber-based products, on the other hand, is 240% of 1937 demand, and continued growth in these fields is expected to generate substantial new domestic demands for market pulp—demands that the North American wood pulp industry has been expanding to meet.

The outlook for market pulp demand in the United States, however, is in no sense typical of the outlook for world demand. The world outlook is more nearly typified by Great Britain's economy.

In 1952, imports of market pulp supplied 91% of Great Brtain's total pulp needs. Total consumption of wood pulp in Britain last year was equal to only 89% of prewar consumption. Since Britain has no wood resources with which to expand her domestic pulp production, she must rely entirely upon imported fiber to support expansion of several basic fiber-dependent industries upon which her economy depends.

In Great Britain, and, in varying degree, in most of the other countries of the Old World, a steady and significant long-term rise in market pulp requirements is expected. More fiber will be needed, not only for the manufacture of rayon and other new fiber-based products, but, of far greater significance, for the restoration and development of basic paper and paperboard economies. Only through increased imports of market pulp can these basic economic needs be met.

In the past, these Old World markets have looked primarily to Scandinavia for the satisfaction of their basic fiber requirements. In the future, because of the changing pattern of market pulp supply, they must look to North America for an ever-increasing share of their total pulp needs. The expansion of market pulp capacity in North America is supported, in part at least, by a firm conviction that the Old World will solve its economic problems, improve its productivity, and enjoy a steady improvement in its basic standards of living.

Changes in the Pattern of International Trade in Wood Pulp

Just as the pattern of market pulp supply and demand has changed, so too has the pattern of international trade in wood pulp.

In the 1930's, 20 to 25% of this country's total wood pulp requirements were supplied by Europe, as compared with less than 2½% in recent years. In the 1930's, 60% of this country's market pulp requirements came from Europe as compared with less than 13% currently.

Twenty years ago, North America imported from the Old World seven times as much pulp as she shipped to the Old World. In 1951 and 1952, for the first time in peacetime history, North America shipped more pulp to the Old World than she received in return.

Thus, the goal of self-sufficiency in wood pulp has already been achieved by North America. The future problems of the North American pulp and paper industry, accordingly, will be primarily problems generated from within this continent rather than from without. The stability of the North American pulp and paper industry, in the future, will depend primarily upon the intelligence with which these domestic problems are faced and resolved. Overseas imports of wood pulp should never again be the controlling influence in the North American pulp and paper economy that they have so often been in the past.

The next phase in the development of the North American pulp and paper industry, now that the goal of North American self-sufficiency has been reached, should be the emergence of a soundly based North American export trade. The success of this endeavor will depend primarily upon the ability of the North American industry, in the future, to meet Scandinavian competition in "Old World" markets.

Prospects for the development of a successful North American export market in wood pulp appear good, for the pattern of relative advantages in world wood pulp production has also changed significantly in recent years. Not only is this true as regards comparative wood availabilities and average wood costs at home and abroad, but it is equally true as regards relative operating efficiencies. In the 20-year period from 1935 to 1955, the productive capacity of the North American wood pulp industry will have tripled, while productive capacity in the rest of the World will have declined. Obviously, any industry in which two thirds of the productive facilities

are less than 20 years old is *per se* an efficient industry, and one well able to compete in world markets. Improvements in the relative efficiency and productivity of the North American wood pulp industry should, in the future, more than offset the marked competitive advantage that low wage rates have given overseas pulp producers in years past.

Summary

Historically, the erratic gyrations of the market pulp supply and the even greater gyrations of prices of wood pulp in this market, have resulted in equally volatile markets for paper, paperboard, rayon, and other pulp-dependent products.

The position of the North American wood pulp industry, and its competitive strength in world markets, should be weighed, however, *not* in the light of conditions as they existed 15 or 20 years ago, but rather in the light of conditions as they exist today and as they will exist tomorrow. New circumstances demand new perspectives and new criteria.

The status of the North American pulp and paper industry and its relative position in the World's pulp and paper economy have changed completely in the past 15 years.

These changes in basic relationships, and particularly the achievement of North American self-sufficiency in fiber, afford real promise of a more stable future, not only for the North American wood pulp industry, but for all pulp-dependent industries in North America—the paper and paperboard industry, the fiber container industry, the rayon and cellophane industries, the printing and publishing industry, and the converted paper products industries.

L. K. Larson
Weyerhaeuser Timber Co.

Tree Farms

Latest data through October released by the American Forest Products Industries, show that approximately 29,000,000 acres are now being utilized for tree farms, of which 16,800,000 acres are located in the South alone. Nationally, Texas has the largest number of tree farms, 485, covering 3,254,147 acres. The West Coast has about 9,700,000 acres devoted to tree farms, which number 631.

Forestry

Available from the American Paper and Pulp Association, 122 E. 42nd St., New York, N. Y., a booklet entitled "Growing Trees in a Free Country," defines forest policies which the Forest Industries Council recommended for keeping our woodlands productive.

Felts for Refugees

Paper and board mills have contributed about 112,000 lb. of used paper machine felts to the American Friends Service Committee's program of foreign rehabilitation. The felts have been used for blankets, clothing, tents, etc., in Korea, Japan, and in refugee camps in Europe. Additional contributions would be welcome and should be sent to the Committee's warehouse at 20 S. 12th St., Philadelphia 7, Pa.

Panama

Effective Dec. 6, 1953, duties on toilet tissue, paper towels, and paper napkins imported by Panama were increased to give further protection to domestic producers. The changes are as follows: toilet paper, 0.30 (0.025) per gross kilogram; paper towels, 30% ad valorem; paper napkins, per gross kilogram, 0.20 (0.03) (duties in Balboas (1 Balboa = U. S. $1.00) with former duties shown in parentheses). *Note:* United States exports to Panama in 1952 were: toilet tissue, $92,265; paper towels, $16,530, and paper napkins, $29,567.

Mexico

The Ministry of Economy in Mexico on October 9 placed the following articles under import control: pulp for the manufacture of paper; pulp for the manufacture of artificial fibers; paper waste and clippings; and paper manufactured from sulphite pulp for the manufacture of dynamite cartridges.

Argentina

Argentina has offered to pay sterling for the 30,000 tons of cellulose yet to be delivered to her under the 50,000 ton agreement made with Sweden earlier this year. Deliveries had been held up, but are now expected to be resumed, payment having been clarified.

Saskatchewan

Press dispatches from Regina, Saskatchewan, state that the Anglo-Canadian Pulp and Paper Co. is investigating the possibility of building a pulp mill 50 miles northeast of Prince Albert. This investigation is still in the very early stages, but information indicates that initial mill capacity would be 100,000 cords of pulpwood a year, and that kraft paper would be produced.

Canada

In Canada at the turn of the century there were just over 50 pulp and paper mills employing 6000 people who produced $8.6 million worth of materials. Today there are 130 mills employing 60,000 people permanently (as many as 390,000 are hired during seasonal wood operations) who are paid $400 million to put out $1.2 billion worth of newsprint, fine paper, cardboard, pulp, and other miscellaneous products.

The pulp and paper industry is, in effect, the spinal cord of the Canadian economy for the following reasons: (a) this is the largest single item of export and earner of "dollars"; (b) the industry pays high wages to a large segment of the Canadian population; (c) historically, demand for pulp and paper products follows population changes—and Canada is growing.

This does not imply that the industry is free from troubles. Taking the industry by its divisions, this report will review briefly, some of the facts we feel should be better known to United States executives. We do have more than just pulp and paper in our minds when we suggest that Canadians take more effective steps to tell of the industry's conditions in the United States (particularly with respect to newsprint). We have in mind industries in both countries that do business back and forth across the border. In actual fact, the state of relations between the newsprint producers in Canada and their American customers affects the broad aspect of a vitally needed, active, and efficiently working United States-Canadian trade.

I—The Newsprint Group. The companies are: Abitibi, Anglo-Canadian, Anglo-Newfoundland, Bowaters-Newfoundland, Consolidated, Donnacona, Donohue, Great Lakes, Maclaren, the McCormick (Chicago *Tribune*, N. Y. *Daily News*) group—Ontario Paper & Quebec North Shore, Mersey, Pacific Mills, Powell River, and St. Lawrence Corp. These firms are listed in the newsprint section because newsprint is their major product. It should be pointed out, though, that their total volume includes other pulp and paper products, and—in many cases—hydro power is sold.

Broadly speaking these companies are in good financial condition, according to a report issued by Greenshields & Co., corporate financiers, Montreal. Coupled with the program of expansion recorded since the end of the war (58% increased newsprint capacity, costing $600 million in new plants, machinery, and equipment), "the industry as a whole is in an excellent position to take advantage of any favorable future trends."

Some "favorable future trends" appear to be developing at present. The United States, which takes about 85% of Canada's newsprint production, has reported increased needs so far this year of 3% over last year, and the recent Paley Report predicts the American market will need 45% more in 1975 than it does now. Yet, the picture is not all favorable.

Dating back to the end of the war, plant and wage costs to the industry began to climb at a rather alarming rate, as did the cost of getting wood to the mills. Modern machines,

mechanization of many operations formerly done by hand, and other cost-cutting procedures were undertaken throughout the industry. Good results have been and are being obtained in the plants, but it has not been possible to do much about wood costs, now the world's highest (except in the West Coast area, where the climate is more stable). Added to this factor has been the new strength of the Canadian dollar which resulted in the loss of the premium on the United States dollar (most newsprint company contracts call for payment in United States dollars).

The investment firm of Jones Heward & Co., Montreal, in a recent report, stated that the 1952 $10 per ton increase on newsprint delivered at New York was not sufficient to offset the above-mentioned cost increases and dollar premium loss. The report also points out that companies have had reduced income from the sale of surplus pulp.

Net earnings on several newsprint operations are suffering from cost problems, and a few operations are close to the break-even point. Some relief may show up in the year-end reports as a result of the slight gain in strength of the American dollar, the small reduction in Canadian taxes, and the $10 per ton increase on newsprint delivered in Canada (7% of total output), but officials of the industry are concerned. On the problem of wood costs, some feel that the world markets will turn to inferior grades if the Canadian costs are not held in check, and even reduced. It was pointed out that Scandinavian and southern United States mills have lower wood costs than the Canadian mills, and lately they have been getting a larger share of the business even though their grades are inferior.

The Canadians are frequently charged with underproducing. It is true that, until this year, the demand exceeded the capacity, but when the situation is examined one can't help but see the tremendous increase in capacity, and note that it has developed within financial soundness. It is necessary to keep in mind that in addition to capital expenditures the companies have had high maintenance and repair bills. In 1952 they totaled $70 million for the industry, and since the war they have totaled $360 million. Today the gap between supply and demand has closed, and capacity is slightly in excess of demand. The Greenshields survey reveals that the demand should remain steady at the present level.

The matter of pricing can be summed up by noting that as little as a 5% drop in United States demand can mean the difference between breaking even or earning a fair return for most companies. For this reason no firms rely exclusively on one American customer.

II—The Fine Paper Group. The companies are: Eddy, Provincial, Howard Smith, Rolland, and Westminster. Book, magazine, writing, and other specialty papers are produced. These organizations had a disappointing year in 1952 with production of 12.7% from the 1951 level. So far this year, however, the companies have demonstrated a sharp recovery. Confronted with many of the same cost problems as the newsprint group, the fine paper firms have had to undertake large programs for cost reduction.

The export picture is not so large in this field, and the United States is hardly involved at all. Howard Smith exports to the United Kingdom, South Africa, New Zealand, Australia, South America, and some other countries, and is the largest in the group. Eddy has some export volume. Rolland and the others are primarily domestic operators. As such, they are not happy about recent government trade concessions which—without the consent of the industry—opened the Canadian market to United States and other foreign fine paper producers in exchange for a trade deal that doesn't benefit any part of the pulp and paper industry.

With regard to the future, if foreign competition is to become a permanent factor of greater importance than it is at present a more costly marketing program will have to be undertaken.

III—The Pulp Group. The companies are: Alaska Pine & Cellulose; Bathurst; Brompton; Brown Co.; Fraser; Minas Basin; and Dryden, now controlled by Anglo-Canadian This group has suffered greatly from high cost factors. Prices have been forced to a point where they are not fully competitive with producers in other countries and some lines have actually been reduced this year, such as bleached sulphite by $5.00 a ton, and unbleached by $10 a ton, in order to build up volume.

Scandinavian competition is keen. The United States met 18% of its needs for pulp through imports from abroad, mostly Sweden, last year, and the figure may be higher this year. Still, according to Toronto's *Financial Post*, "Canadian producers now account for 30–35% of all pulp moving in international trade, against about an 11% slice prewar." The pulp producers have gained measurably by the growth of the Canadian domestic market, too. The pulp producers are more interested in increased foreign markets, including the United States than the fine paper group, and are doing everything possible to be competitive. However, it will be necessary for certain nations to easy currency controls, before their markets can be opened to the Canadians.

IV—The Miscellaneous Group. This is the group of companies that is concerned primarily with the wrapping and packaging of articles. Like the other groups, the activity is widespread, and has most of the same problems. The unique point is that the fluctuation is more sensitive, and thus running at capacity is more difficult to insure. The leaders in the group are: Barber-Ellis, Canadian Wallpaper, Canadian Wirebound Boxes, Corrugated Paper Box, Dominion Containers, Hendershot Paper, Hinde and Dauche, and J. C. Wilson.

This special report on Canada's pulp and paper industry is taken from the *Canadian Enterprise Gazette* of Oct. 1, 1953, published by The Canadian Enterprise Co., Cleveland, Ohio.

Florida

Florida's eight pulp and paper mills are currently turning out over 4000 tons of pulp daily, 92% of which is made into paper and paper products. In 1952, the pulp and paper mills in the state made products valued at about $200,000,000. Approximately 9000 persons were employed by the mills themselves, with a total payroll amounting to $30,000,000. . . . In 1952, forested lands throughout the state furnished 1,583,000 cords of the estimated 2,400,000 cords of pulpwood used by these mills, the balance coming from Georgia and Alabama.

U.K.

United Kingdom's importers of paper and board will be allowed to spend £3 million (U. S. $'s 8,400,000) f.o.b., more on purchases from abroad in the first 6 months of 1954 than the last half of 1953. Purchases for the first half of next year are expected to be £13,000,000 (U. S. $'s 36,000,000).

Europe

United Nations experts meeting in Rome last month forecast that Europe would be able to find only 85% of its pulpwood, small-sized roundwood, and pitprop imports she will need in 1954.

Sweden-France

Swedish-French Trade Protocol covering trade between the two countries for October, 1953 to March 31, 1954, amounts to $7,722,000, covering newsprint, wallboard, pulp, lumber, and paper products.

Finland

Forest Products Exports

The gloomy views prevailing since the Spring of 1953 on the outlook for Finland's forest product exports have yielded

to a more optimistic attitude as the result of the tendency recently manifested in the world market toward stabilization of prices and the strengthening of demand. This year's entire production of sawn lumber has already been sold and sales of most paper grades have been progressing satisfactorily. While the prices obtained represent a major reduction from those of the 1951 boom they are still higher than the pre-Korea quotations, and representatives of the export industry privately admit that the problem of production costs in relation to existing prices has been somewhat exaggerated. Only in the case of cellulose has it been clearly established that costs exceed prices by a considerable margin. These factors, coupled with the gradual improvement taking place in Finland's terms of trade, make it unlikely that recourse will be had to devaluation to improve the competitive position of the export industry.

Wallboard

Finland's wallboard industry has a dual basis. It aims at producing a building material easy to use and possessing a good insulating ability. Secondly, a forest country like Finland must attempt to utilize the sawing waste in its entirety as a raw material for production and not, for example, burn it as fuel.

Finland has eight wallboard factories. Enso-Gutzeit Oy owns The Insulite Co. of Finland in Kymi and Parviaisen Tehtaat (Parviainen Mills) at Säynätsalo, and Messrs. A. Ahlström Oy have their fiber board factory at Pihlava. All three plants make both porous and hard board; The Insulite Co. also manufactures enameled board for wall tiles. Oy Savo has a fiberboard mill in Kuopio, the production plants of Heinolan Faneritehdas Oy are in Heinola and those of O. Y. Wilh. Schauman in Savonlinna. They manufacture only hardboard. Sammon Rulla Oy in Kuopio and Hackman & Co. at Honkalahti have so far turned out only porous board. The total machine capacity of the mills is estimated at approximately 165,000 tons and Finland is consequently third after the United States and Sweden in world production. Production figures for 1950–53 are as follows:

	1950, tons	*1951, tons*	*1952, tons*	*Jan. 1 to June 30, 1953, tons*
Porous	42,123	63,384	49,513	25,980
Hard	36,627	53,884	34,821	19,405
Total	78,750	117,268	84,334	45,385

In Finland, in contrast to other countries, wallboard production is largely an export industry. Domestic consumption, however, has increased, as is clear from the following table of domestic (prefabricated wooden houses included) and export sales in 1950–53.

	Porous		*Hard*		*Total*	
Year	*Finland, tons*	*Exports, tons*	*Finland, tons*	*Exports, tons*	*Finland, tons*	*Exports, tons*
1950	23,116	21,697	5,752	27,487	28,868	49,184
1951	34,366	27,720	9,385	41,152	43,751	68,872
1952	33,176	17,446	11,732	27,078	44,908	44,524
1953						
Jan. 1–June 30	17,461	8,466	5,103	13,974	22,564	22,440

The fluctuations in the quantities exported to different countries in 1950–53 can be seen from the list of purchasers (porous and hard board together):

Country	*1950, tons*	*1951, tons*	*1952, tons*	*1953, 1/1–30/6, tons*
England	14,714	14,861	3341	2776
Holland	6,546	5,726	6706	3476
Australia	5,874	7,822	1090	. .
Denmark	4,785	9,426	5277	3277
Belgium	3,967	2,611	4540	1976
Argentina	2,457	7,304	3275	. .
Uruguay	1,394	366	190	17
United States	1,173	3,951	2934	2574
Switzerland	921	162	339	56
Western Germany	864	1,483	4829	2138
Israel	803	3,377	2492	105
France	341	510	1623	2029
Union of South Africa	707	1,063	1151	451
India	984	1,180	270	184
Greece	10	303	156	825
Venezuela	255	213	312	399
Other countries	3,389	8,514	5999	2154

Finland's wallboard factories, for the most part quite new establishments, are planned with a view to export production. They aim at the maximum elasticity of production so that according to demand in world markets either porous or hard board can be stepped up. Some time ago, for instance, the demand for hard board—which competes with plywood in some uses—was lively in international markets. Today the emphasis is shifting over to porous wallboard. Many countries have not yet been able to deal with their housing shortage. Porous wallboard will be needed immediately the economic situation of various countries permits the effective solution of their reconstruction problem. The good building properties of wallboard, still unknown to many people engaged in construction and repair work, will then gain wider recognition. Today consumption is so uneven that while Sweden, e.g., consumes about 25, Norway 15, the United States and Canada may be 10 kg. of wallboard per capita, consumption in some European countries is only about 3 kg. per capita. Many countries with large populations, e.g., India and China, consume far less than this.

SWEDEN

Swedish production of chemical pulp during the first semester of 1953 averaged 197,733 metric tons per month as against 207,450 tons monthly in the first half of 1952 and 209,083 in the like period of 1951. This year's production remained quite stable between 185,700 and 200,500 tons monthly except for a jump to 220,100 tons during the month of March.

Exports of pulp (chemical and mechanical) averaged 153,376 tons per month in the first 6 months of 1953 as compared to 124,220 tons and 175,657 tons in the first halves of 1952 and 1951 respectively. Shipments dropped seasonally, from 210,000 tons in January (a postwar high for that month) to 62,000 tons in February before leveling off in the Spring at about 190,000 tons.

Revenue from the foreign sales of pulp were very far below the levels of preceding years and directly affected Sweden's entire balance of payments' situation. Exports of chemical (and mechanical) pulp to all countries dropped in f.o.b. value from 978,018,000 crowns (U. S. $'s 195,604,000) in the first half of 1952 to 509,900,000 crowns ($101,980,000) in the second half of that year and to 567,417,000 crowns ($113,484,000) in the first half of 1953. Although official statistics are not yet complete the value of sales to the United States of all types of pulp *rose* from 48,918,000 crowns ($9,794,000) in the first half of 1952 to 87,030,000 crowns ($17,408,000) in the first half of 1953. When sales to the United States and other dollar countries are included, the increase in dollar revenue proves to be the brightest aspect of Sweden's favorable turn in foreign trade this year.

Statistics bring out the striking fact that the measure of recovery in Sweden's pulp industry is directly the result of the threefold increase in pulp tonnage sold to the United States. Among Sweden's pulp customers the United States has jumped from fourth place in the first half of 1952 to second place in a like period of 1953, displacing France and West

Germany and receiving a volume equivalent to 60% of the deliveries to the United Kingdom. While most of the tonnage consigned to New York remained bleached sulphate all the other grades increased over last year's volume by more than 300%. Since only the top qualities are being purchased by American buyers and the New York prices remained generally below European quotations the reason for this dollar export success—without tangible Swedish Government assistance—must be found in the slower European than American pulp demand and in a fundamentally new realization in Sweden that henceforth the American market determines world demand and prices and in the long run is more stable and therefore more remunerative to Scandinavian sellers.

The price (and demand) for newsprint were the most stable in the paper field sliding almost imperceptibly from 658 crowns ($132) per metric tons in January to 628 ($126) in June. This year's output was reportedly sold out for the year. The prices for wrapping papers moved downward although they recovered from May to June. Kraft wrapping declined from 963 crowns ($193) to 887 crowns ($177) from January to June while sulphite wrapping moved from 1143 crowns ($299) to 1088 crowns ($218) and other wrapping from 835 crowns ($167) to 786 crowns ($157) per ton during the same interval. Domestic wrapping paper prices were cut 150 crowns ($30) in May but were raised by 70 crowns ($14) (to normal) in September. In mid-January the Scandinavian paper produces associations decided not to lower their export quotations on wrapping papers but these were reduced by 10 to 12% in mid-June to recognize the sluggish demand and induce larger sales—in this case a successful expedient.

In the other principal grades the decline in prices was just as pronounced. For instance, the average f. o. b. export prices for coated papers dropped from 1825 crowns ($365) in January to 1556 crowns ($311) in June, and that of cellulose wadding from 1571 crowns ($316) to 1463 crowns ($293) in the same period. But other grades were more stable such as coated papers which actually rose from 1108 crowns ($222) to 1125 crowns ($225) parchment, greaseproof and glassine which declined from 1372 crowns ($272) to 1255 crowns ($251) and coarse tissue from 1321 crowns ($262) to 1207 crowns ($241) from January to June. Even board, the production and output of which increased by 6000 and 3000 tons, respectively, over the first half of 1952 showed a decline in average export price quotations, from 892 crowns ($178) in January to 830 crowns ($166) in June.

Paper sales to the United States have improved this year. While shipments of newsprint declined from 8634 to 7402 tons in the first halves of 1952 and 1953, respectively, the exports of cardboard rose from 323 to 1105 tons in the same period, and kraft and sulphite wrapping from 265 to 9275 tons and from 164 to 817 tons in the same period, respectively. By the end of August cumulative American shipments this year were 10,000 tons newsprint, 10,000 tons kraft wrapping, 1,000 tons board, and 1200 sulphite wrapping as against 7,580, 466, 521, and 279 tons respectively, in the first 8 months of 1952. The American market is a small but remunerative outlet for Swedish producers who respect and value it now more than ever.

An important development in the paper industry has been the addition this year of about 80,000 metric tons to annual capacity. Statens Skogsindustrier AB (government-owned) installed a versatile paper machine of 15,000 to 30,000 tons capacity (depending on grade made) at Kalix at the head of the Bothnian Gulf and has made room for a second machine alongside. Korsnäs AB installed Sweden's largest sack paper machine of 527 centimeter width and 30,000 to 40,000 tons capacity in January and by June had worked out all the bugs." Billeruds AB installed in almost identical machine at Säffle (north of Göteborg) this Spring and now has the flow sheet running smoothly. All three machines were built by Karlstads Mekaniska Verkstad and run at a speed of 450

Rear view of the converting plant of the American Israel Paper Mills

meters per minute "comparable with the largest in the United States," according to the plant director.

Japan

Japan's foreign exchange budget for imports in the October 1953, to March, 1954 period has been set at $1,658,693,000. Dollar exchange for pulp imports has been set at $16,226,000 as follows: rayon pulp, $12,976,000; paper pulp, $2,010,000, and cotton linter pulp at $1,240,000 (*Foreign Commerce Weekly*—11/17/53).

Israel

American Israeli Paper Mills, now in operation at Hadera, Israel, are expected to produce 12,000 to 14,000 tons per year of kraft paper, cement bag paper, newsprint, and writing and printing papers. The plant is expected to supply more than 50% of Israel's requirements of these items.

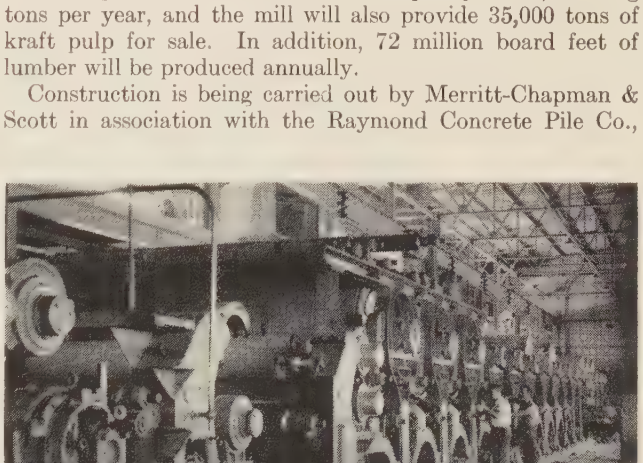
New Zealand

Tasman

Appointments have been announced by Sandwell and Co., consulting engineers of Vancouver, B. C., in connection with the Murupara project near Auckland, N. Z. Resident engineer for the $40 million design and construction project for Tasman Pulp and Paper Co. is E. S. Barton of Vancouver. Other appointments are: C. U. Rapson, civil engineer, R. D. Wilson, electrical engineer, T. J. McKie, field engineer, and J. G. Brown, cost control auditor.

The project is scheduled for completion in July, 1955. Its one newsprint machine will have a capacity of 75,000 long tons per year, and the mill will also provide 35,000 tons of kraft pulp for sale. In addition, 72 million board feet of lumber will be produced annually.

Construction is being carried out by Merritt-Chapman & Scott in association with the Raymond Concrete Pile Co.,



The paper machine of the American Israel Paper Mills from the wet end

New York, and the Fletcher Construction Co., Auckland, N. Z.

N. Z. Forest Products

New Zealand's prime minister Holland is scheduled to open the Kinleith mills of N. Z. Forest Products, Ltd. on Feb. 20, 1954. Cabinet members, members of parliament, and government department heads will also be present. The pulp and paper mills are expected to be in full production at that time and the visitors will be taken on conducted tours of all departments.

Philippines

A Canadian chemical engineer, sent by the United Nations Technical Assistance Administration, left recently for the Philippines to assist the authorities in drawing up a plan for a projected expansion of the country's paper pulp industry.

Harry Collinge, the expert, said at United Nations Headquarters that the Philippine government has been considering the possibility of expanding its present paper and pulp industry in view of the growing need for newsprint and other paper. The country has at present a cardboard factory on the outskirts of Manila, a paper mill in Bais and another in Cebu, he said.

At the government's request, a survey of the situation, particularly with regard to the availability of suitable raw materials, was made by a joint FAO/TAA mission. Work now has reached a point, Mr. Collinge said, where additional economic and commercial advice on the technical problems of paper and pulp manufacture was needed preparatory to the submission of broad recommendations. He is being sent to provide this advice.

The expert added that it was hoped that the mission would have ready by March-April, 1954, a report on broad recommendations on the possibility of expanding the present paper and pulp industry.

Mr. Collinge, who is a consulting chemical engineer, has been associated with the Canadian paper industry since 1931. In 1952 he was in India as a private consultant on paper and pulp industry development. He has also served in a similar capacity in Australia and New Zealand.

Before leaving for Manila, Mr. Collinge paid a brief visit to UN Headquarters to confer with officials of the Technical Assistance Administration. He will also visit Rome to consult with officials of the Food and Agriculture Organization.

Italy

Papermaking has flourished in Italy since ancient times; as early as 1254, paper was manufactured in Fabriano and in 1283, two paper mills there were given to the monks of Montefano. Briquet, the famous historian and scholar of Geneva, also mentions Fabriano as the birthplace of the European paper industry. (F. Weber Co., Philadelphia, import one of the world's few remaining hand-made drawing papers from Cartiere Milani in Fabriano—from a mill over 450 years old.) As early as 1310 Le Marche had some 30 mills. From there, skillful papermakers carried the industry to Bologna, Colle Val d'Elsa, Venice, Padua, and Turin. Italian paper was very well thought of and found a ready market in all of civilized Europe. The papermaking process and various manufacturing secrets were subsequently carried abroad and by 1600 had spread far beyond the Mediterranean countries.

Political objections to the introduction of machinery, difficulties due to the scarcity of wood suitable for the manufacture of mechanical pulp, and in general, the political conditions of the time, did not permit the national papermaking industry to reach the level it had attained in other European countries until the proclamation of Italian unity in 1870. The greatest development took place during the first decade of this century; by 1910 the number of continuous paper machines had risen to 586. Since that time, the development of the industry has continued steadily, although somewhat more slowly. In 1937, the date of the last industrial census, continuous machines in operation totaled 658. Since that time there has been no evidence of appreciable change. It must be pointed out that a count of machines cannot alone give an accurate idea of the progress that has been realized. Today, there have been such notable advances in the mechanics of papermaking that the introduction of a new machine, even one of no exceptional capacity, can mean the replacement of 2 or 3 good machines of the old type, with a definite increase in productive capacity.

The Italian paper industry is in a position to satisfy amply all domestic needs, both in quality and quantity. Every type of paper and board is produced, including ordinary, fine and very fine printing papers; machine made and hand made; Bible papers; special papers for magazines and illustrated newspapers (produced by a specialized group of mills); writing papers, from the coarsest to the finest; ledger, drawing, and cigarette papers; typewriter and mimeograph papers and many photographic and industrial specialties. The production of fine-quality wrapping papers, an export item, occupies a number of mills.

Straw papers are made in groups of factories in Lucchesia, in Tivoli near Rome, around Lake Maggiore, and in Emilia. Most of these are small plants but a few large ones are equipped for large-scale production of thin and colored straw papers for export.

Fine and coarse board production includes all the various types in use throughout the world; too numerous to list here. Vulcanized, glazed, sand coated, and tarred varieties are produced in quantities large enough to permit heavy exports after domestic needs are met.

The papermaking industry in Italy involves over 350 firms with about 435 plants; about 80% of the production potential being located in Northern Italy. A recent estimate placed employees (paper, board, pulp) at the 40,000 figure. There are many small firms—some of them shirtsleeve family enterprises—but Italy's large industrial concerns are on a par with their counterparts in other countries in terms of technical equipment, types of products, and productive capacity. The recent war did no serious damage to the industry, in fact, postwar production has already surpassed the figures for the highest prewar years. This is a laudable achievement in view of the fact that considerable reconstruction was required.

Europe

The following report on Western Europe's pulp and paper industry is by P. R. Sandwell, president of Sandwell and Co. Ltd., Vancouver, B. C.

France

Here the industry is a paper industry, depending on pulp imports. Its basic technical problem is a shortage of raw materials. The forests in France are small. They are located mostly in the foothills of the Alps and in the Bordeaux district, where plantation forests appear.

P. R. Sandwell, Sandwell & Co., Ltd.

Traditionally, France depends on wood pulp from Scandinavia, which she buys at world prices. The French papermakers now have to reconcile these prices with (1) their foreign exchange difficulties, and (2) the fact that they are still selling on a controlled market.

This has led to some attention being devoted to the manufacture of pulp from straw. Here the French in-

dustry has made important technical advances in pulp manufacture. The use of straw pulp, however, is limited. It is a short-fibered material of little strength, which makes it unsuitable for such paper products as bags, which require structural strength, and newsprint, which is produced at high speed and requires strength during manufacture.

The quest for raw materials has spread into the French colonial possessions. In North Africa, experimentation is being carried out with grasses. Research is under way in laboratories in metropolitan France and in field stations in Equatorial Africa on the use of tropical and subtropical woods.

However, if the French had access to woods in the temperate zone, or pulp, they would not be too interested in substitute materials, because they are expensive to produce.

The French paper itself is not as modern as it might be because: (1) many mills are quite old and present economic conditions do not justify replacements, and (2) the relatively modern plants built before World War II were not properly maintained during the war, and have not been maintained or improved extensively since the war owing to lack of capital.

A good many French mills are owned by families whose once-adequate resources have been hit by the deflated currency.

Switzerland

A pulp and paper industry operates in Switzerland on quite small scale. The mills are small and diversified, that is, a single mill will produce a wide range of products, from newsprint to fine papers.

Manufactured paper products are for domestic use chiefly. Pulpwood is partly Swiss-produced and partly imported. Canada has supplied the Swiss industry with some. It is interesting to note that shortly after the war, the Swiss bought some pulpwood from the French who cut it in Germany.

The Swiss paper industry is having difficulty at this time with the German and Swedish paper industries. They are, however, technically excellent. Their manufacturing methods are quite modern. Their paper quality is very high. They are paying a lot of attention to the conservation of heat and electrical energy, a feature which is common to most Swiss industry now.

Austria

In the United States zone, there has been a large program of rehabilitation of the pulp and paper industry. A considerable amount of equipment has been sent there from the United States under the foreign aid program.

Germany

One of the main problems of the rebuilding German pulp and paper industry is raw materials. Eastern countries where pulpwood was bought in the past have been lost. Western forests have been exploited by French occupation forces who used the forests as a means of exacting reparations without regard to future yield. This has made pulpwood hard to get and expensive.

But in spite of this, German mills have been extensively modernized since the war, mostly with machinery of their own design and manufacture, all displaying the usual high qualities of German manufacture.

As a result of the occupation of the eastern zone by the Russians, there has been a surplus of engineers and chemists developed in western German industry. In the pulp and paper industry, their talents are being used in research into new pulping methods and new raw materials.

As a result of this, the Germans have built up a pool of knowledge which may well be applied on a licensing basis elsewhere in the world, particularly in undeveloped countries. In South America and the Middle East already one finds German influence growing on an important scale. Their strength is in their intelligence, rather than in their material resources.

Finland

In Finland's pulp and paper industry, there has been a program of expansion, motivated by a desire to: (1) make up for the country's material losses to Russia, and (2) increase Finnish income from foreign countries by making more pulp and paper and by carrying the manufacturing processes to further degrees, that is, selling bleached instead of unbleached pulp, and marketing paper where before they marketed pulp.

In this expansion program, the Finns have been influenced by United States ideas. They have built large pulp and paper plants. This is the result of extensive United States credits which are used to buy United States equipment.

The Finns also have a native ingenuity for pulp and paper manufacture. The effect of this is apparent in the improvements in processing and plant layout one is able to see.

The Finns are also paying more attention than most people to the aesthetics of mill design. Most are designed with the advice of leading contemporary architects. Efficiency and working conditions are thus at a high level. Most mills are built in remote places where new towns are required. The industry has not left its towns to grow haphazardly, but has planned them, most of them involving handsome apartment buildings. They are not company towns necessarily, and in many cases, the housing is financed by housing institutions and not the pulp and paper industry.

Difficulties of the industry in Finland have to do with the country's highly inflated currency. This is the result of Finland having let wages rise too rapidly during the period of reparation payments to Russia, and also because of a reluctance by the Finns to free or devaluate their currency because of the effect they feared this would have on foreign loans.

Finland is essentially a country without capital. The Finns, however, are completing mills and embarking on new ones even though the economics under current price conditions are probably all against them. They take the view that if they are to exist at all, a modern industry is essential.

All productive capacity being built is for export purposes, but their capital and other costs are so high it is difficult to see how they could undercut world prices and stand it for long.

Sweden

The Swedish pulp and paper industry went through a program of modernization following the war. This program was stimulated by the manner in which capital expenditures in Sweden are treated for tax purposes. Depreciation allowances are flexible—for example, a company with high profits could charge a large proportion of depreciation in the year in question, leaving little to be charged off later.

These modernization programs were for the purpose of increasing efficiency and economy by labor-saving devices, conservation of raw materials, neat and power, etc. There has been, however, no appreciable increase in production, because production is limited by raw materials and the labor supply.

If modernization of Swedish plants could have resulted in a saving of raw material, labor output and production could have been pushed up. But there has been no production expansion as we have experienced in Canada where our only bottleneck has been markets, and where we have had adequate labor, raw material, and capital.

There has been some upgrading in paper manufacture in Sweden, but this trend is not as marked as it is in Finland.

The Swedes' marketing policy bears examination. We speak of the Swedish pulp and paper industry as one. Actually there is as much difference in policy among groups within the industry as there is between Sweden as a whole and this country. Their policy has been to maintain production under any circumstances, and to allow prices to rise and fall to the extent the market is able to stand it.

As a result, before 1952 profits were extremely high. They were used to offset high depreciation allowances and export

taxes imposed by the Swedish government, presumably to build up a fund to support the industry in bad times.

In times, like 1952, pulp prices were allowed to go down and down, and presumably could have dropped to the point where the loss was equal to the loss mills would have suffered if closed altogether. This has meant a loss of much of the liquid assets of Swedish mills in the past 18 months, so that today, some of them are hard up for cash. A rise in commodity prices, however, would mean a quick build-up of reserves again.

In Sweden, as in Finland, it is not common for mills to control their own material by outright ownership. They depend on outright purchase from private owners. Here, too, there are important developments. Traditionally the low cost of Swedish pulpwood was attributable to the low cost of transporting it on rivers. Residents of regions through which the rivers passed would assist in log drives at nominal fees.

Since the war, however, this has become unionized, particularly in Finland, and river transportation costs have increased. In some cases, it has become cheaper to truck pulpwood than drive it down streams.

Great Britain

The industry is divided into two parts: (1) newsprint manufacture and (2) the rest.

The British newsprint industry is quite modern. It developed during the thirties when it was economical to buy pulp and pulpwood from Scandinavia at very low prices and convert it into newsprint in the vicinity of London.

The industry was very hard hit during the war, and as recently as 1948 was operating at only 20% capacity. Since then, production has been increased, and the tendency has been to manufacture other products besides newsprint in mills originally designed for newsprint.

An interesting anomaly of the industry is that newsprint is being manufactured in Britain and shipped to Australia, while Britain is buying Scandinavian newsprint. The reason for this is that Australia has a tariff against Scandinavian newsprint.

The rest of the British paper industry consists of old, small mills, very much like France. They are plagued by the raw materials problem, there being no forests in the country of any importance. There is, thus, an ever-present interest in the use of agricultural waste and other wood substitutes.

Also, as in France, there is production of some very high-grade specialty papers.

Waste Treatment

Legislation

The following item is from the August *News Letter* of the New England Interstate Water Pollution Control Commission:

"Of far-reaching potential significance as a possible model for similar action in other states was the recent legislative enactment in Wisconsin of a bill to give industries special tax concessions for money spent on facilities for the control of water and air pollution.

"The Wisconsin Act (Chapter 183 of the Laws of 1953) exempts waste treatment facilities from local property taxes for five years and allows industries for State Income Tax purposes to amortize investments in such works over a 5-year period instead of 20 years. These tax concessions will be allowed for pollution control facilities installed as a result of any orders or recommendations of duly authorized state or local agencies. Earnings from by-products developed through the use of the abatement equipment would be applied as an offset.

"A further example of legislative action to aid industry in providing treatment works was the enactment by the West Virginia Legislature of Chapter 145 of the Acts of 1953, which invests industries with the right to take land for treatment plants by eminent domain. This right is contingent upon an application to the State Water Commission, and the entry by the Commission of an order finding that the use of the land is necessary in connection with the control of pollution and directing the applicant to use the land for such purpose within a reasonable time after the acquisition."

Purification in Small Streams

Continued observation of a number of small streams and drainage ditches where the flowage consists primarily of kraft or news and chip board mill wastes during the Summer months indicates that extremely high rates of purification occur. Where little or no dilution is present, seven miles of flowage at low velocity reduced the oxygen demand of combined kraft mill waste 50%. Five miles of flowage served to reduce the demand of news and chip mill waste over 75%.

Acetic Acid

Two processes were developed and evaluated for producing acetic acid from neutral sulphite semichemical pulping liquors by the Council's Virginia Polytechnic Institute project of the National Council for Stream Improvement, under the direction of Frank J. Vilbrandt. Removal of this acid from the liquor would greatly reduce its B.O.D. value. While both processes were found capable of producing acceptable acid at relatively low cost, it is doubtful if they could compete with the acetic acid from the methanol process by which the bulk of this product is now made. This is particularly the case when the small size of semichemical pulping installations is considered. The results of this research, together with a market evaluation, will be the subject of a technical bulletin now in preparation.

Publications

The following bulletins are available from the National Council for Stream Improvement, Inc., 271 Madison Ave., New York, N. Y.: No. 42, Interim Report; No. 43, Interim Report; No. 56, Federal Legislative Report—83rd Congress, first session (HR 5431-2 and 5623); Nos. 57 and 58, State Legislative Report—1953 sessions; No. 59, Federal Legislative Report—83rd Congress, first session (HR 6789); No. 61, Soil Stabilization of Sulphite Waste Liquor Storage Lagoons; No. 62, Treatment of Calcium-Organic Sludges Obtained from Lime Treatment of Kraft Pulp Mill Effluents—Part I; No. 63, Design and Operating Criteria for Primary Treatment of Deinking Waste.

Strawboard Waste

During the past year the National Council for Stream Improvement's strawboard waste project, under the direction of D. E. Bloodgood at Purdue University, has concentrated its effort toward finding an economical and compact means for disposing of primary sludge produced on simple settling of the waste. Anaerobic digestion is believed to be the most promising means for converting this slimy and odorous residue to a compact and inoffensive humus which could be disposed of as a soil conditioner.

Spent Liquor Utilization

Research grants to the University of Wisconsin and the University of Minnesota totaling $4500 for studies bearing on utilization of spent sulphite liquor were announced recently by the Sulphite Pulp Manufacturers' Research League.

Two grants to the Departments of Poultry Husbandry at the University of Wisconsin and the University of Minnesota provide fellowships to investigate those values of torula yeast which remain unknown in the feeding of poultry. Torula yeast is manufactured from the sugars in spent sulphite liquor by a subsidiary of Rhinelander Paper Co., and a larger torula yeast plant is now being constructed by Charmin Paper Mills at Green Bay.

A third grant goes to the Engineering Experiment Station t Madison for studies on road construction and maintenance vith sulphite roadbinder. The particular objective is to tudy the use of this material in the prevention of Spring reakup in blacktop and unpaved roads. Sulphite liquor for oadbinder is now provided to highway and street authorities, t the bare cost of hauling, by nine Wisconsin sulphite mills as means of reducing pollution.

HILCO

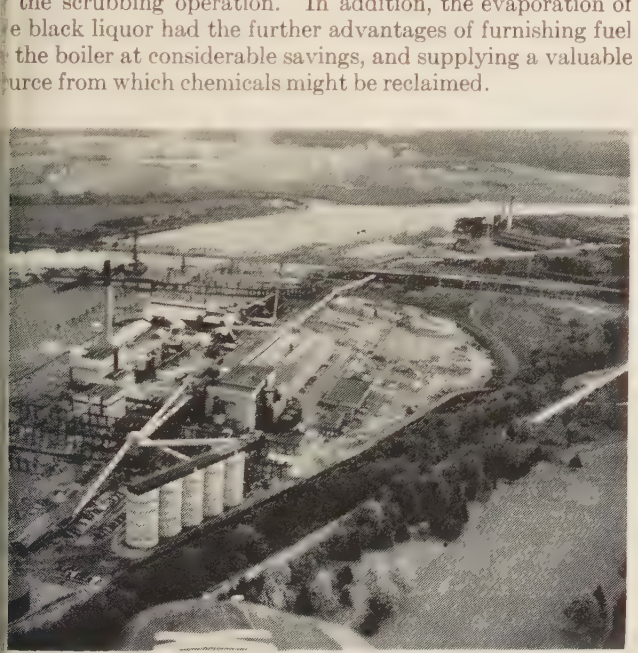
Thilmany Pulp & Paper Co., Kaukauna, Wis., has carried ut an extensive smoke-abatement program in recent years hat has resulted in a reduction in stack discharge from 0,000 to 5,000 lb. per day while production of pulp has increased from 120 to 230 tons per day.

In 1942, Thilmany engaged the New York engineering firm f Babcock and Wilcox for the purpose of designing and instaling a smoke-abatement system. Later, a small model unit as made, employing the venturi tube principle, in which a quid is sprayed into the hot flue gases as they pass through ne constricted throat of a tube, absorbing the chemical parcles. The cost of this small model was some $3000, and hen it proved feasible, installation of a full-scale unit was ade in No. 6 boiler in 1949, at a cost of approximately 45,000. In the No. 6 boiler system, water was used as the rubbing agent, and enabled the scrubber to drastically reuce the amount of chemical dust carried up and out of the ack.

Incidentally, Thilmany scored first in the installation of ne venturi scrubber, for it was the first and only one of its nd in the world. It has proved so successful that the venri system is being adopted by other paper mills, and has reived wide attention throughout the steel industry as well.

In 1952, with pulp production increased from 148 tons per ay in 1949, to 151 tons in 1950, to 165 tons per day in 1951, nd finally to 200 tons per day in 1952, it was necessary to inall new boiler equipment in order to meet the increased deand for steam. And along with the new boiler, a new venri system was needed.

Thilmany engineers, working with the Babcock and Wilcox o., found that black liquor, a product of the digesters, ould be used as a scrubbing agent, increasing the efficiency the scrubbing operation. In addition, the evaporation of e black liquor had the further advantages of furnishing fuel the boiler at considerable savings, and supplying a valuable urce from which chemicals might be reclaimed.



om the air, the aluminum-jacketed conveyor belt is ible evidence of Weyerhaeuser's integrated forestoducts plants on the banks of the Snohomish River. e new kraft mill is in the foreground; sawmill C is st to the right of the kraft stack; sawmill B is back of the bridge, around the water tower

Chips from Weyerhaeuser's two adjacent lumber-division sawmills are conveyed to this "nerve center" near the chip storage silos. Other chips arrive at the kraft mill by rail from two other company sawmills

The cost of this project has been high, since it involved the abandonment of No. 6 boiler (including the original venturi scrubber), which is valued at $186,000. The new heat recovery boiler installation and venturi scrubber have cost Thilmany $1,175,000.

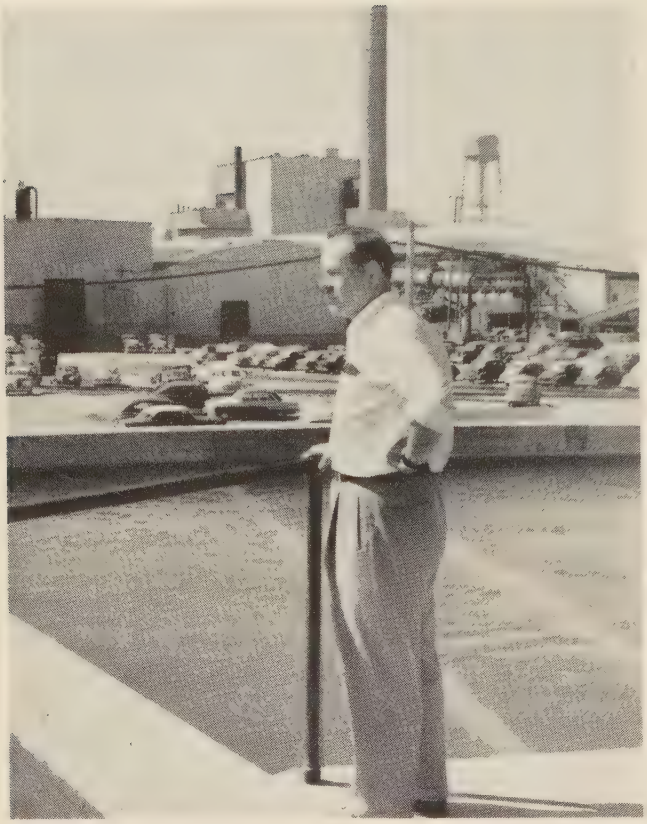
In addition to the venturi scrubber unit, Thilmany has taken other drastic, effective measures toward the alleviation of the smoke problem. For instance, Multiclone units have been installed on all coal burning boilers and the lime kilns at the Lower Mill. Multiclones serve to remove cinders and fly ash from these stacks. Cost of these Multiclone installations alone was $16,000.

One of the main sources of smoke and dust used to be the coal burning cranes employed in the wood yard for the handling of pulp logs. These have been replaced with diesel cranes at a cost of $125,000.

K-C

John R. Kimberly has been appointed president of Kimberly-Clark Corp., Neenah, Wis. Cola G. Parker, previously K-C president, is now chairman of the board. W. R. Kellett was appointed executive vice-president, F. S. Seaborne was made vice-president of manufacturing, and W. H. Swanson is now vice-president in charge of research and development.

First sheets of pulp came out of the machine in early September. This scene was typical of the new Weyerhauser plant's "shake-down" period



Gerald Alcorn, Weyerhaeuser's pulp-division supervising engineer, designed and supervised construction of the company's new kraft mill. He stands here at the plant's water-treating facilities

Directing Weyerhaeuser's Everett pulp division mills i Branch Manager, Russell J. LeRoux (right), who is scan ning the new kraft mill's organization chart with kraf Superintendent, Jerry Willins

National Container

Ernest E. Brown has been appointed general manager of the multiwall and specialty bag plants of National Container Corp.

National has recently acquired the assets of Allied Paper Bag Corp., Kansas City, Mo. The corporation operates another multiwall bag plant, a paper mill, 19 corrugated box shops, and fine pulp, board, and paper mills, with a new 500-ton-per-day mill now in the final stage of construction at Valdosta, Ga.

Hudson

Hudson Pulp & Paper Co. has leased two floors of the new Simon Bros. office building at 477 Madison Ave., New York, N. Y. The executive offices of the company will be at this address early in 1954.

West Virginia

Coordination of the activities of West Virginia Pulp and Paper Co. and its new subsidiary, Hinde and Dauch Paper Co., began recently when the following H & D directors were added to the Westvaco board: Sidney Frohman, chairman of the board of H & D, Charles E. Frohman, president of H & D, and George R. Birkelund, president of Baker, Fentress & Co., of Chicago.

Weyerhaeuser

The new kraft mill of the Weyerhaeuser Timber Co. at Everett, Wash., is producing 250 tons of bleached kraft pulp entirely from chips made from leftover edgings and trimmings resulting from the company's sawmill operations. A complete description of the mill, pictures of which appear in this issue, may be found in the November issue of *Tappi* on pages 114A and 115A.

Brown Corp.

J. M. Jopp has been appointed assistant to the president in charge of engineering of the Brown Corp., La Tuque, Que.

MacMillan

The MacMillan & Bloedel Forestry division is using heli copters for seeding and protection of its Ash River and Coppe Canyon timberlands. Poisoned wheat that has been dyed green so that useful wild life cannot see it is spread over the ground to reduce the mouse population. Tests have shown that 35 mice to the acre will eat up to 12,000 seeds per day Douglas-fir seed trees are left at suitable intervals to seed cut over areas wherever possible, and helicopters are used to spread seed over areas too far from seed trees to receive natural seeding.

Union Bag

Union Bag & Paper Corp.'s Pulp and Paper division set two production records in October. On October 31 the divi sion turned out a world's record 24-hr. production of 205 tons of kraft paper and paperboard. Average production for the month was also a record at 1801 tons per day. J. R. Lientz, division manager and member of the TAPPI executive committee, pointed out that maximum efficiency and excellent interdepartmental coordination were required to make the 175 carloads of pulpwood into finished products each day. T. T. Dunn, vice-president and resident manager congratulated J. Piette, pulp mill superintendent, C. E. Jackson, paper machine superintendent, and G. E. Jackson, woodyard superintendent for the outstanding production.

Mando

Minnesota and Ontario Paper Co. has added a 20 by 72-ft. 3-story building to its control laboratory at International Falls, Minn. The new addition is part of Mando's extensive program of modernization and improvement of its facilities that has now gone over the $40 million mark.

Gould

The new bleach plant of the Gould Paper Co., Lyons Falls N. Y., is scheduled for operation shortly. Gould's presen

leachery is used for peroxide bleaching of groundwood-sulphite mixtures. The new plant will use calcium hypochlorite to bleach sulphite only.

TRATHMORE

C. M. Bryan, chairman of the board of the Strathmore aper Co., West Springfield, Mass., has announced that trathmore has purchased the Keith Paper Co. of Turners alls, Mass. It was also announced that Strathmore intends maintain Keith as a separate organization at this time, ther than merging it in as an operation division of the trathmore mills. By its acquisition of the Keith Paper Co., trathmore has complemented its present equipment with achines capable of producing papers of the types made by trathmore.

Aside from changes in the top executive level occasioned the change in ownership, Strathmore is not contemplating y major changes in the operating personnel at Keith. he new officers are: F. Nelson Bridgham, president; C. M. ryan, vice-president; Paul A. Wilks, treasurer and clerk; enneth A. Sheridan, assistant treasurer and mill manager; mes H. Sweet, sales manager. The new directors are: Nelson Bridgham, C. M. Bryan, Harry E. Riggs, Laurence . Shattuck, and Paul A. Wilks.

At the time of the acquisition, the officers of the Keith aper Co. were: Aaron Krock, president; James H. Sweet, ce-president and general manager; William Roberts, treaser; Herbert Gold, assistant treasurer; and William Tucker erk.

The chief executives of Strathmore are: C. M. Bryan, airman of the board; F. Nelson Bridgham, president; arry E. Riggs, vice-president in charge of sales; Arthur E. attuck, vice-president; and Paul A. Wilks, treasurer. her members of the Executive Committee are: L. W. Shatck, general superintendent, and Henry D. Johnston, assistt to the president.

It was stated that Strathmore is planning to make changes the Keith mill and operating methods in order to bring em into harmony with Strathmore operations. Equipment Keith consists of four fourdrinier paper machines. Products e listed as rag content bond, ledger, papeterie, writing, index, ion skin, text, technical specialties, tracing, chart, and awing papers. Strathmore has one fourdrinier and two ecial machines at its West Springfield mills and three fourinier machines at its Woronoco mills. Strathmore products lude text, cover, bond, writing, vellum, bristol, blue print, ist, and specialty papers.

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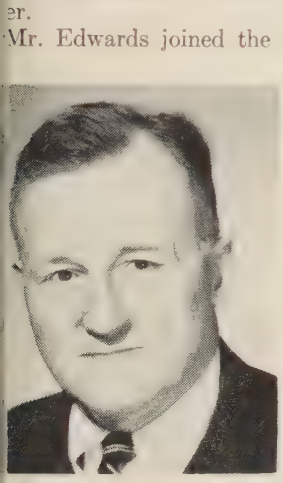
Appointment of T. T. Edwards as manager of the Whippany plant of the Container division of International Paper ., was announced recently by W. S. Snyder, general manger.

Mr. Edwards joined the Container Division in 1945 and served in various capacities at the Chicago and Springhill plants before being appointed assistant manager of the Whippany plant in 1948. He is assuming duties formerly handled by R. D. Maffitt who resigned on Dec. 1, 1953.



hn F. Howden, International Paper Co.

At a meeting of the board of directors of International Paper Co. recently John F. Howden was elected a vice-president of the company, it was announced by John H. Hinman, president. He will handle special administrative problems that are developing with greater frequency along with the growth of the company. Mr. Howden has been employed by the company for the past 21 years devoting his time largely to legal problems.

Crossett

As a further step in utilization, the Crossett Lumber Co., Crossett, Ark., is installing a $400,000 system for debarking and handling its sawlogs before they enter the mill. The new installation will make the resulting clean slabs and other by-products of sawing available for chipping to help supply the nearby pulp plant of Crossett Paper Mills Co. Easier sorting and storing by species is part of the plan. The barker is of a mechanical type.

PCF

Penobscot Chemical Fibre Co., 211 Congress St., Boston 10, Mass., has recently finished and put into operation its new Zaremba black liquor evaporator. This is a falling-film type, six-body, quintuple effect evaporator with capacity for handling liquor from 150 tons of pulp. It takes the place of four evaporators which have been in operation at the company's Great Works, Maine mills for many years. Edward W. Keith is superintendent of Penobscot's soda pulp division.

Riegel

C. W. Hoffman has been appointed assistant manager of converted glassine sales of the Riegel Paper Corp., 260 Madison Ave., New York, N. Y.

Brown Co.

Onco, one of the specialty products of Brown Co., Berlin, N. H., is a rubber-impregnated sheet which is laminated for use in the shoe industry for innersoles and sock liners, as well as in the novelty field for pocketbooks, handbags, luggage reinforcements, hat brims, wallets, belts, etc.

St. Regis

Extensive new laboratory facilities have recently been completed at the St. Regis Paper Co.'s Kraft Center at Pensacola, Fla. The 60 by 70-ft. wing in the center's new four-story administration building provides laboratory and office space for carrying out the St. Regis multiwall bag research and development program. This is conducted in conjunction with the St. Regis central technical laboratory in Deferiet, N. Y.

The Kraft Center's laboratory is equipped primarily for evaluation and developmental work on multiwall bags and the conversion materials used in their manufacture, including paper. Many features have been especially designed for the laboratory which contains a broad variety of testing equipment. The new laboratory is made up of a conversion material laboratory, a chemical laboratory, a high humidity room and a bag testing laboratory. A special room contains the mechanical equipment which serves the laboratory facilities.

Conversion materials for all the St. Regis plants in the United States, Canada, and Puerto Rico are tested in the conversion materials testing laboratory to protect the plants against possible use of defective materials. Samples from each shipment are subjected to plant trials and tested by the laboratory before the shipment is approved for use in production. A file and graphic analysis are maintained of the paper tests made by each of the St. Regis kraft paper mills. In addition, this department tests outturn samples from all shipments of paper purchased by St. Regis from other companies. The department facilities are available to assist St. Regis' foreign licenses in their multiwall bag research and development.

The conversion material testing laboratory is conditioned to 73°F. and 50% R.H. (relative humidity). However, it

may be operated over a wide range of temperatures and humidities for special studies. This insulated laboratory is housed in a 16 by 30-ft. room with tile walls. Work surface consists of 60 ft. of benches and tables with St. Regis Panelyte tops and curbing.

Paper testing equipment in this room includes basis weight, caliper, mullen, tear, tensile, stretch, porosity, smoothness, scuff, stiffness, and folding endurance testers. A new A. van der Korput dynamic tensile tester has recently been added to this equipment. Also available is equipment for testing thread, filter cord, rope, and miscellaneous conversion materials and films. Access to other specialized testing facilities is available through the Kraft Center's paper mill laboratory and the Central Technical laboratory in Deferiet.

Chemical laboratory equipment includes ovens, an analytical balance, scales, pH meter, refractometer, blenders, viscosimeter, TAPPI M.V.P. (moisture vapor penetration) cups, and Wink-type paper moisture content cups. The temperature of the 10 by 30-ft. room is maintained at 73°F. and the humidity at 45–55%. Work space includes 34 ft. of benches, a desk, and a 20-ft-section of storage and dispensing cabinets.

The high humidity room, which is maintained at 90% R.H. and 100°F., is designed to accelerate the evaluation of variously constructed bags, films, closures, seams, adhesives, valves, and sleeves as moisture or grease barriers. North and south walls of the 12 by 20-ft. room are lined with aluminum racks with tracks. These can accommodate 80 aluminum four-wheel 18 by 40-in. carts. Each cart will take one full size bag or a number of test pouches.

The high humidity room and bag test laboratory are especially constructed to permit testing under severe atmospheric conditions. Floor composition consists of the following layers: 5 in. cement, asphalt barrier, 2 in. insulation material, asphalt barrier, aluminum foil, 5 in. cement. Walls and ceilings are covered by three separate layers of sheet aluminum with $^3/_4$-in. space between the layers. All joints in each layer are sealed by lead tape and the first layer is integral with the aluminum foil in the floor. The fourth exposed wall is of 16 gage satin finish aluminum sheeting sealed by aluminum stripping with gasket-type seal.

Simultaneous testing of two different sets of bags and materials, one in each end of the 18 by 60-ft. room, is possible in the bag test laboratory. A suction grill to the air conditioning equipment is located in each end of the room to prevent intermixing of the materials. An 18 by 30-ft. grill-type mezzanine floor which extends over the east end of the room provides storage space and ready access to much of the mechanical equipment and the dust collector. The mezzanine floor is served by a $^1/_2$-ton monorail hoist and, if necessary, also by a $^1/_4$-ton monorail hoist which normally serves the packers in the west end of the room.

Located along the north wall in the east end of the room is the following St. Regis equipment: elevator, tilt table, and end drop testers as well as a St. Regis 107-FC one tube commercial packer for cement and similar materials. A screw conveyor in this end of the room receives the material from bags broken during testing, moves it to a bucket elevator after which it is passed through a slotted screen and returned to the hopper above the packer.

The screw conveyor with the covering grill is closed at floor level by a number of sections of removable steel plates. Any one of these plates may be removed when material is to be dumped from the broken bags. A dust collector with suction at the packer and also at the boot of the screw conveyor controls the dust problem.

In the west end of the room are the following pieces of St. Regis equipment: a portable cement repacker, 100-LS screw packer for flour, sugar, fertilizer, and similar materials, a flat drop tester, and an end drop tester. Sewing machines for sewn open mouth bags—one for small sugar pockets and the other for large bags—and a wax dipping bath complete th permanent equipment. A St. Regis 100-LF gravity-typ packer for calcium chloride and corrosive chemicals is bein secured.

The main door of the bag test laboratory is of the stainles steel refrigerator type with a small double glass inspectio window and is approached through a vestibule. Doubl refrigerator type doors also provide access to this room fro outdoors for bringing in equipment and supplies.

Controls for the air conditioning units for both the ba test and high humidity rooms are grouped in the center of th south wall of the bag test laboratory. Power panels fo equipment and lighting circuits are also provided at thi central location. A 6-in. cement curb at the junction of th floor and the aluminum walls of the bag test laboratory pro vides a location for electrical outlets since all power condui is buried in the floor. Provision is also made in the curbin at the south wall for the accommodation of special equipmen

Air conditioning equipment for the laboratory is locate in a mechanical equipment room which has 1400 sq. ft. o floor space on two levels. The three air conditioned labora tories have resistance-actuated electronic indicating and re cording pneumatic controls which have full proportionin and reset features.

The conversion material test laboratory is served by a $7^1/_2$ ton sealed unit with auxiliary reheat and rehumidificatio coils. Air for the high humidity room is treated by a humid fication and heating unit located in a room directly above it This service room is conditioned to 95°F. to provide heate air and prevent rusting and corrosion of the conditionin unit. Conditioned air is admitted to the high humidit room through six louvers spaced around the walls of the roo near the floor level and under the aluminum racks. Exhaus air leaves the room through two ducts in the ceiling. A condensation, particularly on the floor, has been eliminate by this reverse flow method.

The bag test laboratory is provided with a very flexible ai conditioning system which permits maintaining condition from 15 to 90% R.H. and 40 to 100°F. The poorer perfor ance of bags at low humidities and temperatures is a se sonal problem in the bag industry. This room was design to permit the study of bag performance under those con ti tions. The conditioning system contains the following equ ment: a continuous curtain oil bath air cleaner to prevent du from the room and chemicals in the air from getting onto th conditioning equipment, a drier, a 50-ton compressor with 16-bank direct expansion cooling, coil, reheat coil, rehumidi fication element, and 6000-c.f.m. fan. The control panel i the bag test laboratory has pneumatic switches which contro all of the elements of the system. These switches permit an proportion of the air to be by-passed around the drier o around the direct expansion cooling coil by separate contro

The 150-lb. steam pressure required by the drier is reduce to 10 p.s.i. by a steam reduction valve. Steam reductio stations are located at the various conditioning units to re duce the 10 p.s.i. steam to the proper pressure for the par ticular conditions being maintained in the laboratories Ponds of water on the roofs of the laboratory building reduc the load on the air conditioning units and conserve wate An evaporative cooling tower on the roof of the main buildin permits reuse of the cooling water for the air conditionin units.

St. Regis research facilities are designed to provide maxi mum service to the company's customers. The Technica Departments of the St. Regis Printing, Publication an Converting Paper Div., Multiwall Bag and Kraft Paper Div were consolidated in 1951 under K. A. Arnold.

Offices of the Central Technical Department are located i Deferiet, N. Y. The St. Regis Kraft Center's laboratory i directed by Robert P. Anderson.

St. Regis has announced the appointment of Arch Carswe

the newly created position of vice-president in charge of les of all products of the company. Mr. Carswell has been ce-president in charge of sales of the Multiwall Packaging iv.

Edward G. Murray, vice-president in charges of sales of e Printing, Publication and Converting Paper Div.; Regiald L. Vayo, vice-president in charges of sales of the Kraft iv.; and C. Russell Mahaney, vice-president and general anager of the Panelyte Div., will work with Mr. Carswell coordinating sales of all of the company's products and will ntinue to direct sales in their respective divisions.

Mr. Carswell, who joined St. Regis in 1928, was named a ce-president in 1949 and was elected to the board of direcrs in October, 1952.

AIR

Norman F. Greenway, vice-president in charge of folding rton operations at Robert Gair Co., Inc., New York, anunced the appointment effective November 1 of John H. ttinger, Sr., as assistant manager of Gair's Thames River, nn., division.

th Anniversary

The Tonawanda Boxboards Div. of Robert Gair Co., Inc., ns the city of Tonawanda in celebrating 50th anniversaries.

The city and concern were "wed" in 1903—the same year nawanda became a city—and have enjoyed a half-century progress since then.

In 1903, Tonawanda Board and Paper Co., was completed the spot where the Niagara River, Barge Canal, and Tonanda Creek met. The first sheet of paperboard was rolled d before the year was out this paper mill—the first allctric one—was turning out the impressive quantity of 60 ns a day.

The mill had its ups and downs until the Robert Gair Co. rchased it in 1926 and began operating it as the Tonawanda xboards Div. Since then, the mill has provided continuous ployment for local residents. It operated even through the depression when many other industrial plants were ced to shut down completely or run on reduced schedules.

When Gair took over the mill, it needed a complete overhaul. mpany records show the modernization included "rebuild the wet ends of the machines, adding some driers to the 2 machine, installing new pumps for pumping stock, and uilding the beaters."

Today, 320 employees work on three shifts to produce 230 s of paperboards every 24 hours. The entire output, sold gely to independent boxmakers, is made into folding and ip cartons of every size, shape, and description. For their k, the Tonawanda employees are paid more than $1,000,000 ear—most of which flows into local channels.

Gair records show that 70% of the personnel has been with company more than 5 years; 34% of the group has 15 more years of service, 14% 25 years or more.

ob security has always been an important reason for lik to work at Tonawanda Boxboards. But it's not the only son; the various employee benefits also rate high marks. example, the company provides several types of insurance: accident, and sickness, hospitalization, and surgical. s insurance program does more than just take care of the xpected bills, however. Last year, under this plan, 20 ential employees were born at that division at an average to their parents of only $44 each.

n addition, the company provides a well-equipped first room; arranges for the operation of a Safety Committee; s one, two, or three-week vacations depending on length service; sponsors a wide variety of social and athletic vities; and under a suggestion system, gives cash awards workable improvement ideas.

GLATFELTER

P. H. Glatfelter, president of the P. H. Glatfelter Co., of Spring Grove, Pa., is one of five men to receive an American Forestry Association conservation award for 1953. In presenting the award, Robert N. Hoskins, chairman of the AFA award committee, referred to Mr. Glatfelter's conservation accomplishments as: "Perhaps the East's most distinguished example of what true enlightened industrial leadership can accomplish in making the community a better place in which to live. This man's contributions have gone far beyond the borders of his own state as he has practiced the sound American philosophy of self-help and good neighborliness."

The Pennsylvania paper manufacturer's citation pointed to his great vision and leadership in establishing a company forestry department and taking the message that "timber is a crop" to "countless farmers and woodland owners." Mr. Glatfelter's pioneering work in the use of oak for wood pulp was also mentioned in the citation. The P. H. Glatfelter Co. operates certified Tree Farms in Pennsylvania, Maryland, and Virginia. Mr. Glatfelter is treasurer of American Forest Products Industries, the national coordinator of the Tree Farm program. He is a former head of the Pennsylvania Forestry Assn.

Others who received conservations awards this year included: Sherman Adams, assistant to President Eisenhower and former governor of New Hampshire; George L. Drake, of Shelton, Wash., president of the Society of American Foresters and a Penn State alumnus; Thomas V. Downing, assistant state supervisor of agricultural education for Virginia; and Ernest H. Linford, Salt Lake City editorial writer.

President Eisenhower opened the Fourth American Forest Congress at which awards were made.

RHINELANDER

Major expansion of research on pulp, paper, and sulphite liquor products got under way recently when Rhinelander Paper Co. Rhinelander, Wis., moved into a new laboratory building with complete scientific equipment and an increased staff. The company leased the structure, a former Soo Line passenger station adjacent to its mill, and has extensively remodeled and equipped it to permit a more active, well-rounded program of research and development activities.

New products and product improvement in the company's pulp and paper lines and in lacquer coatings and wax laminants are a principal field being researched. Also under study are the further potentialities of desugared lignosulphonate solids which are produced by Lake States Yeast Corp., a Rhinelander subsidiary. Lake States grows torula yeast on the sugars in spent sulphite liquor obtained from the parent company's pulping operations, and evaporates the desugared material for sale under the trade name "Toranil." The new laboratory has more than 3000 sq.-ft. of floor space. Besides conventional industrial laboratory equipment, it has a pilot plant area with equipment for making and testing pulp and paper and converted paper products.

POWELL RIVER

Water

In the manufacture of wood pulp and newsprint, water is a raw material almost as important as the wood itself. Water is used for hydraulic power, for the hydraulic barking of wood, for pulp washing, for making steam, and as a fluid for conveying the wood pulp through the various processes to the pulp drying machine and the paper machines.

Powell Lake is the source of a large supply of clean, fresh water for the various mill processes. We use about 195 tons of water or 47,000 U. S. gallons for each ton of newsprint produced. In processing alone, the water used daily amounts to 51.8 million U. S. gallons. This is nearly two thirds of the

82.3 million gallons used by all the industries and residents of the Greater Vancouver area, with a population of 600,000.

However, largest percentage of water goes into hydraulic power. Powell Lake supplies the equivalent of almost 2 billion U. S. gallons per day, to produce about 50,000 hp. The Lois Lake system supplies another 560 million U. S. gallons per day to produce about 35,000 hp. of hydro-electric power at Stillwater. This power is transmitted over a 13-mile long transmission line to Powell River.

The total amount of water consumed for all purposes aggregates 3850 cu. ft. per second, equivalent to $2^1/_2$ billion U. S. gallons daily. This would be sufficient to supply more than two communities the size of greater New York which uses just over a billion gallons per day.

Powell Lake, the largest source of water power in the area, is 30 miles long, 45 square miles in area, and has a watershed or drainage area of 580 square miles. The mountains in the far reaches rise to over 6500 ft. above sea level, some of them climbing steeply from the edge of the lake. The lake itself is 185 ft. above sea level when full, and has a measured depth at one point near its mouth of 1200 ft. The trout fishing is excellent, and cut-throat trout up to 12 lb. have been caught.

The second source of water, the Lois Lake system, is less spectacular than Powell Lake, but is an interesting and beautiful Pacific Coast chain of lakes. Total water area is 11.5 square miles when full and the watershed is 184 square miles. The mountains are not as high as in the Powell Lake area, but fishing is equally good, especially in some of the more remote, less accessible smaller lakes in the watershed.

The original water source, the rain and snowfall, as everywhere, is always an interesting topic of conversation and is no less so in the Powell River district. Powell River itself is "usually" comparatively warm and sunny with an annual average precipitation of only 35.3 in., which is just a small amount more than the average of 30 in. for Victoria, B. C. However, fortunately for the water supply, the precipitation increases rapidly in all directions from Powell River inland. At the head of Powell Lake it is well over 100 in. annually while at Scanlon Dam on Lois Lake is it 56 in. annually. It is estimated that about 90% of the rain and snowfall reaches the lakes to make up the run-off and furnish our water storage. This is in fortunate contrast to some parts of the world where the loss from evaporation amounts to more than 50%.

Without water the great dailies of New York, London, and and Paris would not be able to bring the world's news to your doorstep. Without water, the great pulp and paper industry of Canada, which produces one half of the world's newsprint could not function.

Hydraulic Barking

Among outstanding innovations in the pulp and paper industry in recent years has been the application of the hydraulic process to the barking of wood. So fast is the tempo of modern industry, that even old-time employees of Powell River Co. are already speaking reminiscently of the "old drum barkers." Yet it is only 7 years ago since the first hydraulic barking equipment was installed in the plant. The drum barkers had been in steady operation for 34 years.

Powell River Co. pioneered hydraulic barking in the Canadian pulp and paper industry, with the installation of a Weyerhaeuser-type hydraulic barker in December, 1946. This was basically similar to the original barker installed by Weyerhaeuser in 1942, but contained several features specially designed by Powell River engineers. In this type, the log is revolved and water ejected through $^5/_8$-in. nozzles at pressure of 1200 lb. to the square inch. This barker has operated continuously since that date—and has resulted in substantial saving of wood over the old drum type.

With the speedup of paper machines in the last two years, additional barking capacity was necessary. In 1952, a ring-type barker was added which can handle small as well as large logs—and replaces the small log barking equipme installed in 1947. This equipment permits the use of co siderable quantities of salvage wood from logged-over are Salvaged logs are usually towed to paper mills in bundl weighing up to 40 tons and measuring about 7 ft. in diamet by 60 ft. long. They contain logs varying from 6 to 26 i in diameter.

The bundles are lifted out of the water by an overhead cra onto the log deck and from there are fed onto a roll ca After being cut into lengths by a swing saw they are co veyed into the barker. The ring barker operates differentl than does the Weyerhaeuser barker. The log is pass through a rapidly rotating ring which has two or more jets water aimed at its center. This ring barker has both ho zontal and vertical movement to adjust its location to su various sizes and shapes of logs. Logs up to 44 in. in dia eter can be passed through the ring.

The change from the former drum barker has greatly im proved efficiency, has provided safer working conditions and equally important—has worked in with our over-all wo conservation program. An approximate saving of 15% log usage has been effected by the new equipment. In add tion, it has accelerated the utilization of salvage wood fro logged-over areas, again assisting in the preservation of tim ber reserves and forging another link in the chain of perpetu wood supply.

CHARMIN

Charmin Paper Mills, Green Bay, Wis., launched its bigge promotion in history recently with a new slant on the mul ple-unit packages which it pioneered, according to Don Fa bairn, advertising manager.

Charmin is placing three of its famous four-roll packs t gether in a "3-month supply" package it found appealing consumers in recent market tests. The "cheaper by t dozen" suggestion is the basis of full color rotogravure adv tising in 14 key metropolitan markets.

Construction of the world's largest torula yeast plant well under way, according to M. J. Auchter, Charmin's vic president in charge of manufacturing. Foundations and st structure for the new $1^1/_2$ million dollar building are expect to be completed during the winter when work on the sup structure will begin. The new Charmin plant is said to the first large-scale production facility for torula yea When completed in 1954 the new plant is expected to produ about 10 million pounds of the yeast annually.

FALLS

More than twice as much spent sulphite liquor from i pulp mill is being used this year for roadbinder as in 19 Falls Paper and Power Co., Oconto Falls, Wis. announc recently. The 1953 total has exceeded 4,200,000 gallo hauled for roadbinder, as compared with 1,700,000 gallo last year. Forrest W. Brainerd, mill manager, has assured t State Committee on Water Pollution that next year this pr gram will haul at least 6,000,000 gallons. During the fi warm weather months of 1953 when oxygen conditions in t Oconto River may be critical for fish life, the mill kept 20 of its sulphite solids out of the stream by this method a next year will boost this to 30%.

In search of a new and effective approach to stream im provement, Falls is using its huge pile of discarded bark f treating spent sulphite liquor. The company has accum lated behind its mill two acres of useless bark piled 20 to 30 deep. Industry biologists decided that this bark pile mig prove useful in fermenting the oxygen-consuming wood suga which are the troublesome ingredient in spent sulphite liqu and thus get rid of them before the liquor reaches the strea

Using tank trucks normally employed in the compan roadbinder operations, mill technical men for some mont have been pouring spent liquor on the bark pile. Only

ently appreciable amounts of the fluid have begun to appear n the soil beneath the pile. Tests are now being run on soil amples to check penetration, direction of flow, and to as- ertain what has happened to the spent liquor while making ts slow trip through the bark pile.

If the test works out as hoped, it will mark a successful onclusion to an experiment on which Wisconsin sulphite mills pent hundreds of thousands of research dollars and may pro- ide a method of treating dilute liquor and wash water at easonable expense. A dozen years ago the Sulphite Pulp Manufacturers' Research League, working closely with the tate Committee on Water Pollution, built at Appleton a ilot plant for testing on sulphite liquor the trickling filter ock pile technique that is widely used in treating sanitary astes. The Appleton tests proved that the method would do ie job, but only at a construction and operating cost that ould put out of business any mill that might try to use it. o the whole thing was abandoned as impractical.

Expectation of industry technical men is that beneficial acteria deep down in the bark pile and in the soil beneath it ay eat the sugar out of the liquor. Desugared liquor can- ot cause any significant stream pollution, according to state nd industry scientists.

ONSOLIDATED

Clean-up of sulphite pollution in the Fox River came one ep closer today as the Interlake Mill of Consolidated Water ower & Paper Co. finished up a job that is expected to bring ie mill's $600,000 experimental evaporator plant back to rmal operating efficiency.

"The plant was turned on last March and was the first full- ze installation in Wisconsin for evaporating and burning ent sulphite liquor," said G. K. Dickerman, Consolidated's chnical director. "Like any new-type process, this experi- ental plant has faced us with a series of unforseen operat- g problems, so that we have been able to operate the evap- ator plant at an average of only 28.6% of capacity in its st half year after start-up," Dickerman concluded. "This eans it is reducing our pollution of the Fox River a little ore than one quarter as much as we planned it to do. ventually we expect to get that entire experimental installa- n working as a unit. Until we do, we cannot know for sure at its results will prove good enough to carry their own eight."

AMMERMILL

At the meeting of the Pennsylvania Section of the National ouncil for Stream Improvement held at Hershey Pa., on t. 23, 1953, representatives of Hammermill Paper Co. re- rted that, working with the Salvo Chemical Corp. and its rent company, The Sterling Drug Co., a method of apply- g the wet combustion principle of the so-called Zimmerman ocess to semichemical waste liquor was developed. Fol- ving extensive laboratory and small scale pilot plant inves- ations it was decided to build a commercial scale pilot nt at Erie. The experimental installation, costing more an one half million dollars, is now being built by the Dravo rp. of Pittsburgh. The plant is expected to be ready for al about Jan. 1, 1954. If successful, the method may have mise for the treatment of other wastes.

C. Statistics Course

During the Spring quarter of 1954 (March 24 to June 4) the stitute of Statistics of the University of North Carolina will nsor a special program of course work, lectures, and semi- rs on statistics for research engineers, physicists, and emists. The primary objective of this program is to pro- le an opportunity for industrial research workers to acquire working knowledge of modern statistical concepts and tech- ques. Emphasis will be on the efficient design of experi- nts and the analysis of data therefrom. Informal semi- rs on statistical problems submitted by the participating students will be held. Guest lectures will include W. J. Youden and M. G. Kendall. Regular college credit will be granted for course work satisfactorily completed. For further information write to the Institute of Statistics, North Carolina State College, Box 5457, Raleigh, N. C.

Lowell

President Martin J. Lydon has announced the appointment of two new staff members in the Paper Engineering Dept. at the Lowell Technological Institute.

Norwood H. Keeney has been named as assistant professor and he will have charge of the paper converting courses. He is a graduate of Trinity College where he received his Bachelor of Science Degree in Chemistry. Mr. Keeney also accomplished additional study at the University of New Hampshire and received his Master of Science degree in Chemical Engineering (Pulp and Paper) from the University of Maine in 1950. For the past 3 years Professor Keeney has been engaged as a paper chemist and Development engineer with the Fram Corp., Providence, R. I. He is an associate member of the Technical Association of the Pulp and Paper Industry.

Horace N. Lee has been named as an instructor and he will have charge of the courses in paper technology, paper microscopy, and testing. Mr. Lee is a graduate of the University of Maine and received his M.A. Degree from Harvard University. He is the author of numerous papers on wood and paper technology. He is an active member of the Technical Association of the Pulp and Paper Industry and at one time served as chairman of the Microscopy Committee.

Corrosion Short Course

Program plans for the 1954 annual short course in corrosion held by the National Association of Corrosion Engineers are well under way, according to M. F. Adams, N.A.C.E. program chairman and associate chemist, Division of Industrial Research, Washington State College. The 5-day course to be held on the campus of Washington State College at Pullman, Feb. 1–5, 1954, will present a brief but intensive review of the fundamental aspects of corrosion followed by panel discussion and a lectures on the applications of corrosion control in industry. The Division of Industrial Services of the Washington State Institute of Technology is the college sponsor of the course.

The program includes five general topics—fundamentals, practical aspects, corrosion mitigation, materials of construction, and environment. Following are representative presentations to be made under each topic:

Fundamentals: "Physicochemical and Metallurgical Factors," H. H. Uhlig, Professor of Metallurgy, Massachusetts Institute of Technology
Practical Aspects: "Corrosion Testing and Evaluation," F. L. LaQue, Chief, Corrosion Engineering Section, International Nickel Co.
Corrosion Mitigation: "Cathodic Protection and Inhibitors," G. H. Rohrback, Consulting Corrosion Engineer
The Environment: "Process Industry," Aaron Wachter, Chief, Corrosion Research, Shell Development Co.

For further information address requests to Professor E. B. Parker, Director, Division of Industrial Services, State College of Washington, Pullman, Wash.

Basic Materials Show

The second Basic Materials Exposition, the product development show which had its premiere in New York last June, will be held at the International Amphitheatre, Chicago, May 17–20, it was announced by Clapp & Poliak, Inc., New York, founders and producers.

Attendance among top management executives, project engineers, product designers, materials engineers, production experts, research men, and sales and marketing executives at the first show exceeded advance estimates by a large

measure. As a result, the second exposition will be considerably larger and broader in scope.

Exhibition space will be more than doubled and the number of participating companies will be increased by about 50%. Seventy companies contracted for display space prior to the announcement of the second show.

Exhibits are limited to companies producing the basic materials which go into the making of other products. Manufacturers of end products and equipment producers may attend only as visitors.

Tall Oil

Production approaching 1000 tons a day of crude tall oil within the next few years was predicted by A. Scharwachter, president of the Tall Oil Association and vice-president of Arizona Chemical Co., at the semiannual meeting of the Tall Oil Association, at the Cloister, Sea Island, Ga.

Present production of tall oil, an oil obtained from the pine wood used in making kraft paper, is approximately 200,000 tons yearly. Although tall oil is relatively new among industrial oils, its domestic production and uses have increased steadily since the introduction of the product in 1930, he said. Commercial acceptance and use of tall oil, like that of so many industrial oils, has been achieved gradually.

Mr. Scharwachter pointed out to the Association members, who represent the manufacturers and sellers of tall oil, that demands for tall oil rosin exceed the supply. In addition, said Mr. Scharwachter, this increasingly available industrial oil has terrific further potentials in the manufacture of such products as linoleum, paints, soaps, cleansers, adhesives, asphalt emulsions, core oils, fungicides, varnishes, textile oils, and many others. Mr. Scharwachter also predicted that tall oil, which is a natural mixture of rosin acids related to abietic acid and of fatty acids related to linoleic and oleic acids would prompt many new chemical uses within the next 5 years.

L. J. Doyle, vice-president of Union Bag & Paper Corp., and a former president of the Association, called upon the tall oil industry to devote more research toward the development of end uses. He emphasized the fact that the kraft paper industry, the father of the tall oil industry, is healthy because of the time, money, and effort it had put into such research work. Tall oil is such a low-cost readily available raw material, said Mr. Doyle, that it is attractive to potential users. He said it should be the tall oil industry's purpose to teach all industry how to use this versatile source of organic acids.

American Forest Congress

President Eisenhower and two members of his cabinet, Secretaries Benson and McKay, spoke before the opening session of the Fourth American Forest Congress held in Washington, Oct. 29–31, 1953.

Speaking extemporaneously, President Eisenhower said the purpose of the Government is "to understand, if possible, the problems of every special group in this country, but never to use the resources of this country to favor any group at the expense of the others.

"I cannot tell you how much satisfaction it gives to me," the President continued, "to know that intelligent Americans are meeting together whose interests are as broad as this land, whose vision must be projected forward not merely until tomorrow, or possibly an election, but for a century.

"What is going to be the character of this country?" the President asked. "Is it going to favor the individual as it favored us? Is it going to give him an opportunity? Is it going to have the resources to give him that opportunity?

"Or are we going to degenerate into some kind of controlled economy, some kind of regimentation of all the heritage—of all the phases of our heritage that we have received—all the God-given resources and privileges we enjoy?"

Answering his own questions, the President continued: "I believe that every true American wants to pass on, without any stricture, the right to his own determination of what he is fitted for, of how he shall worship, of what he shall earn, of how he can save, and what he can do with his savings. . . ."

Secretary of Agriculture Benson stressed the point that forestry is inseparable from agriculture as he outlined his department's policies in regard to timber resources. "I hope we no longer have any citizens who look upon conservation and preservation as synonymous terms," Secretary Benson declared as he reaffirmed the administration's interest in a strong program of resource development built on conservation through use.

"As forest managers, we must not become so imbued with all resources that we fail to make the land yield up to its full potential of the resource for which it is best fitted," Secretary Benson declared.

Commenting on the Department of Agriculture's review of national forest boundaries, Secretary Benson said: "I want to make it abundantly clear, however, that although some adjustments will occur, the basic structure of the national forests will be maintained. Any adjustments in area or in policy with respect to these lands will be based on what is shown to be in the best permanent public interest as the result of thorough economic studies of each situation.

Summing up the forestry policies and plans for industry, James L. Madden, president of Hollingsworth & Whitney Co., of Boston, declared: "The wood processors and forest owners are alive to their responsibility to see to it that the Nation's tree growing potential is harnessed. They are not planning to divide up shortages, they intend to grow their future."

Sherman Adams, assistant to President Eisenhower, was the Forest Congress banquet speaker. Pointing out that "conservation must be observed in bad times as well as in good," Mr. Adams said, "one of the significant accomplishments of recent years has been the substantial increase in industrial forestry."

Discussions at the Congress were based on the proposed plan for American Forestry which was developed at a conference of leaders of American forestry held at Higgins Lake, Mich., in June of this year. Between 50 and 60 persons formally presented their views at subject-matter sessions in forest management, multiple use, forestry research and education and landownership.

Forest Fire Insurance

The growing of timber as a private enterprise is being handicapped by the general unavailability of forest fire insurance, according to H. B. Shepard, forest economist of the Federal Reserve Bank of Boston, who addressed the annual meeting of The American Society of Mechanical Engineers at the Statler Hotel, New York, on Dec. 4, 1953.

He said the extent to which fire insurance is being placed on forest properties in the United States is "negligible" because of the reluctance of companies to handle this type of insurance.

"It is not possible to detect any strong indication that the established fire insurance organizations intend to promote forest fire insurance as anything more than what they call an 'accommodation' line," he continued. "The evidence points to the prospect that, if forest fire insurance is to become a going business in any real sense, it will be because the forest owners organize their own insurance carrier, or carriers."

He pointed out that for 40 years, owner-operated mutual companies have functioned with conspicuous success in Norway, Sweden, and Finland, and stated that it would be feasible to offer forest fire insurance coverage at premium rates comparable to those which the public is accustomed to paying for insurance on other types of property.

Accident Rates

In 1952 the paper industry duplicated its 1951 performance

of reducing the frequency rate 8%. For all industries combined in 1952, the frequency rate was down 7%; however, the severity rate of the pulp and paper industry increased 1% in 1952 while the corresponding rate for all industries combined was decreasing 9%. This failure of the severity rate to decline in proportion to the frequency rate indicates increased seriousness of the typical injury case.

	1952 rates		Changes, 1951–52, %		Changes, 1935–39–52, %	
	Freq.	Sev.	Freq.	Sev.	Freq.	Sev.
Pulp and Paper	10.06	0.98	− 8	+ 1	−40	−42
All industries	8.40	0.88	− 7	− 9	−36	−43
Rubber	5.96	0.42	+ 1	+17	−25	−42
Chemical	5.10	0.55	− 7	−35	−44	−55
Automobile	3.62	0.35	−19	−24	−65	−57
Wood products	16.27	0.90	−17	−13	0	−14
Lumber	35.48	3.36	−18	−26	−35	−23

Although the industry's severity rate increased only slightly rates of other industries decreased and the rank of this industry slipped from twenty-first among the 40 major industry groups in 1951 to twenty-seventh in 1952. The rank of the industry's frequency rate improved from twenty-fourth to twenty-third.

The severity rates for temporary total cases and permanent partial cases decreased 15 and 6%, respectively. A 17% increase in fatality rate outweighed these changes and resulted in a net increase of 1% in the industry's severity rate.

Accident Rates by Type of Injury

	All injuries	Death and perm. total	Perm. partial	Temporary total
1950–52 frequency rate	10.87	0.07	0.74	10.06
1950–52 severity rate	1.00	0.42	0.34	0.24
1952 frequency rate	10.06	0.07	0.70	9.29
1952 severity rate	0.98	0.42	0.34	0.22
1951–52 changes				
Frequency	− 8%	+17%	−12%	− 7%
Severity	+ 1%	+17%	− 6%	−15%
1935–39–1952 changes				
Frequency	−40%	−50%	− 7%	−41%
Severity	−42%	−50%	−37%	−29%

Since fatalities are not numerous, the 17% increase in fatality rate had little effect on the frequency rate, which decreased 8%. This decrease was determined by decreases of 12% in the frequency of permanent partial cases and 7% in the frequency of temporary total cases.

Although the 1950–52 rates follow the expected pattern of varying inversely with plant size, the 1952 severity rates varied directly with plant size. In the percentage changes from the previous year, this shows itself in a moderate 16% severity rate decrease for middle-sized plants, a 75% decrease for small plants, and a 12% increase for large plants. All size groups showed frequency rate decreases.

Accident Rates by Size of Plant

	Large	Middle-sized	Small
1950–52 frequency rate	8.97	14.38	18.92
1950–52 severity rate	0.95	0.95	1.61
1952 frequency rate	8.53	13.35	16.23
1952 severity rate	1.01	0.91	0.70
1951–1952 changes			
Frequency	− 8%	−13%	−11%
Severity	+12%	−16%	−75%

Employment of Engineering Graduates

A survey of 143 companies employing engineering graduates conducted during the September meeting of the Midwest College Placement Association, yielded the following information:

Regarding demand, the group was asked to compare their requirements for 1954 with those in 1953 in terms of "the same, more, or less." 52% said they wanted the same number, 30% said they wanted more, and 24% said they wanted fewer. A year ago figures on this same question were 56% wanted the same, 33% wanted more, and 10% wanted less. These figures apply to technical graduates including engineers.

Regarding beginning salaries, the following question was asked: "As nearly as you can estimate what will your 1954 gross salary offering be for men without previous business or industrial experience?" Nine per cent specified a figure between $301 and $325; 36% specified a figure between $326 and $350; and 44% placed a figure between $351 and $375. A year ago, the same question produced the following results: 42% placed a figure between $301 and $325; 43% placed a figure between $326 and $350; and 6% placed a figure between $351 and $375. Seventy-seven of these companies reported they were offering the same salary in 1954 as in 1953, and 62 companies reported they would offer a higher salary. It is interesting, perhaps, to note that not one intends to offer a lower salary.

The company representatives were also asked to report on the percentage of the number of men hired in 1953 compared to the number sought. Three companies reported that they hired between 0 and 25% of what they sought. Twenty-four company representatives reported they hired between 26 and 50% of what they sought, 24 hired between 61 and 75% of what they sought, and 64 hired between 76 and 100% of what they sought.

Sixth Bolton Award

Not the least interesting feature of the Bolton Award Contests is the geographical distribution of the prize winners. The judges have no way of knowing names or addresses of contestants as each entry bears only a code number, and impartial decisions are positively assured. Since the beginning of these contests in 1945, 22 different States of the Union and two Canadian Provinces have been represented among the 72 winners. The Sixth Bolton Award is no exception in this respect.

Maine and Ohio each have two winners and the following each have one; Georgia, Massachusetts, Michigan, North Carolina, New Jersey, Texas, Washington, Wisconsin, and Quebec.

The official subject for the Sixth Bolton Award was "The Obligations of a Company to Its Employees." A more important topic alike to management and labor could hardly be imagined, and it has been handled in a constructive manner by all 13 contestants. This book is one which no one interested in industrial relations can afford to miss, be he employer or employee, for it reflects the points of view of executives and workers alike and with singular general unanimity so far as fundamental relationships are concerned. Without premeditation these 13 essays constitute a strong argument for the American way of conducting industry.

It is significant that a paper machine foreman, a chemist, and a training director, in the order named were the winners of the coveted "National Contest." The occupations of the winners of the ten Divisional prizes were equally varied, and every one is worth reading.

Copies of "The Bolton Award, 1953," may be obtained from John W. Bolton and Sons, Inc., Lawrence, Mass.

Patents

The National Association of Manufacturers, 14 W. 49th St., New York, N. Y., has issued a booklet titled "Patents... Progress...and Prosperity" explaining how the patent system operates in a modern, competitive economy.

Bureau of Standards

The U. S. Dept. of Commerce has published a report on the present functions and operations of the National Bureau of Standards, with their evaluation in relation to present national needs and recommendations for the improvement and strengthening of the Bureau.

Forest Genetics

The Forest Genetics Research Foundation, American Trust Building, Berkeley 4, Calif., a nonprofit corporation, is organized to advance research in forest genetics and related sciences as a basis for the improvement of forest trees. Timber economy in this country is approaching a major crossroad. From the virgin forests many are turning to timber as a crop. Already extensive man-made forests are being planted. This timber-cropping economy invites the use of superior types of forest trees. Disease and insect resistant trees should be used in all reforestation. Faster growing varieties are needed. Where can they be obtained?

Genetics, applied by scientific breeders, has created the hybrid corn which now produces 84% of the nation's crop, and similar improvements have been made in grains, fruits, vegetables, and forage plants. What has been done with field crops can be done with trees. Superior new types can be found or created. This has already been accomplished with pines, poplars, and birches.

Wood is used for many purposes, requiring forest trees of different kinds adapted to various conditions. To create better types of trees for these different uses and regions much basic research will be required. This calls for many trained scientists working on long-term projects for which adequate funds are not yet available.

This Foundation is nation-wide. It operates as an intermediary between the research that is needed and the individuals and organizations who wish to devote some of their resources to this important undertaking. The tasks of the Foundation are done by a small office and traveling staff. It maintains no experiment stations or laboratories.

A brochure, describing the work of the Foundation in more detail, will be sent on request.

Forest Products Industries

Leonard G. Carpenter of Minneapolis, Minn., has been elected president of American Forest Products Industries, Inc. Mr. Carpenter is president of McCloud Lumber Co., with lumber manufacturing operations in McCloud, Calif.

Three other presidents of wood-using companies were elected to the board of trustees of the information and educational organization of pulp and paper, lumber, and wood-processing industry. The new trustees are John H. Hinman, president of International Paper Co., New York City; Charles M. Hines, president, Edward Hines Lumber Co., Chicago; and Ernest L. Kurth, president, Angelina County Lumber Co., Keltys, Tex. Officers re-elected were William B. Greeley, Port Gamble, Wash., chairman; Walter J. Damtoft, Champion Paper and Fibre Co., Canton, N. C., and William Swindells, Willamette Valley Lumber Co., Portland, Ore., vice-president; P. H. Glatfelter, P. H. Glatfelter Co., Spring Grove, Pa., treasurer; and Charles A. Gillett, Washington, D. C., secretary and managing director.

Ontario Tree Farm

Certification of Ontario's first tree farm, the 75,000-acre tract of cut-over limits privately owned by The Ontario Paper Co. on Manitoulin Island, took place at Gore Bay on September 16, in a ceremony in which Hon. Welland S. Gemmell, Minister of Lands and Forests for Ontario, presented the much prized certificate to Arthur A. Schmon, president of the company. The event was the culmination of 5 years of hard work on the part of the company in growing trees on fire-swept Manitoulin Island, and marked the company's leading position in the growing movement for the conservation of the country's forest resources.

Present at the ceremony were representatives of the Ontario Government, the Canadian Forestry Association, and faculty of forestry of the University of Toronto, various pulp and paper companies, and students from the Gore Bay public and high schools.

Increased Water Yield

Findings of 12 years of research by the U. S. Forest Service indicate that periodic harvesting and thinning of young trees can produce a permanent increase of 25% in water yield from a watershed. The experiment carried on at Fort Collins, Colo., revealed that as much as 30% more water could be produced from an area when the mature trees were cut in dense virgin stands of lodgepole and Engelmann spruce. These thinnings open up spaces into which Winter snows can pack in greater depth, and hence increase the useful Summer runoff of water.

Lake States Tree Planting

A recent survey conducted by the chairman of the American Pulpwood Association's Lake States Technical Committee shows that pulp mills in Michigan, Minnesota, and Wisconsin will plant 5,000,000 trees a year during the next 10 years on 50,300 acres of their own lands. The survey, covering 34 mills, showed 11 of them now extend regular woodland management aid to small owners in their areas, and last year distributed 914,000 trees to their woodland-owning neighbors at no charge.

A-C

The Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has assumed operation of the Buda Co., Harvey, Ill. A-C president, W. A. Roberts, announced that this addition will be operated as the Buda Co., a division of Allis-Chalmers, and will be headed by Ralph K. Mangan, president and general manager. Mr. Mangan has been president of the Buda Co. since 1950. The company manufactures diesel and gasoline engines and railroad supplies.

Du Pont

Penn R. Lindsay, who has been in sales, research, and production work for E. I. du Pont de Nemours Co. Electrochemicals Dept. since 1936, has been named to the new position of assistant manager of the department's district sales office in Cincinnati, Ohio.

Du Pont neoprene latex is being used to treat kraft paper for disposable work caps. Treated also for flame resistance, the paper caps give greater protection than cloth caps, last as long, and cost much less.

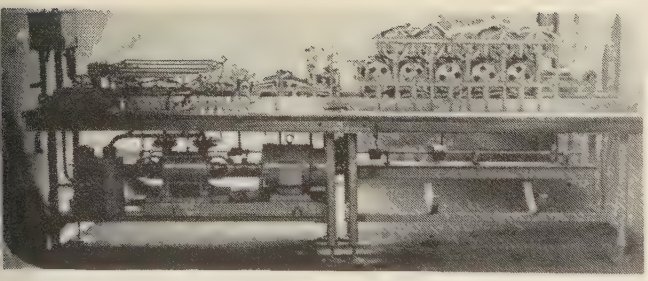
Westinghouse

Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., has published a booklet (B-6090) describing the integral-type Motocylinder for material handling applications, including turning, releasing, raising, or lowering materials in repetitive cycles.

Also published by Westinghouse is a wall chart showing the comparison between old and new NEMA standard dimensions for a.c. motors from 1 to 30 hp.

Parsons and Whittemore

Parsons and Whittemore, Inc., 250 Park Ave., New York, N. Y., has introduced the P & W Midget Fourdrinier Paper Machine, which is claimed to produce paper with only a 9-in. trim but of a quality comparable to a full-size fourdrinier paper machine. Sale price is said to be about one-fifth that of 36-in. trim machines. Requiring 2.5-kw power consumption and one operator only, the machine will produce up to 35 lb. of paper per day at speeds up to 8 f.p.m. Its over-all



The P & W midget fourdrinier paper machine

dimensions are 10 ft. 6 in. long, 2 ft. 8 in. wide, and 4 ft. 6 in. high.

Diamond Power Specialty

The Electronics Div. of Diamond Power Specialty Corp., Lancaster, Ohio, has moved into its new electronics laboratory which is to be used for the continuing development and construction of the Diamond "Utiliscope" (wired television) and for the development of other electronic instruments and controls.

New electronics laboratory of the Diamond Power Spedialty Corp., Lancaster, Ohio

Diamond has just published a bulletin (No. 1137) giving information on the model 69B Blower, which uses a fixed position rotating element to clean a large number of tubes by sweeping through a predetermined arc.

The model TT blower

For cleaning extremely wide boilers, Diamond now offers the model TT blower, for use where the blower nozzle must travel more than 25 ft.

Burgess-Manning

Burgess-Manning Co., Libertyville, Ill., has issued literature on a new series of silencers for air compressors, blowers, vacuum pumps, etc.

Barrett

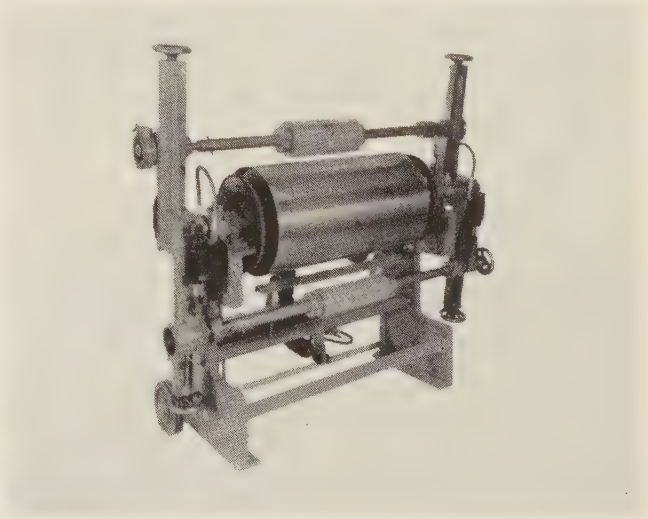
Carleton Ellis, Jr., has been appointed director of sales for all Plaskon products, it was announced by Thomas J. Kinsella, president of the Barrett Div. of Allied Chemical and Dye Corp., which recently purchased the Plaskon division of Libbey-Owens-Ford Glass Co. Sam Gurley, formerly Barrett resin sales manager, is now general sales manager. H. W. DeVore is manager of molding compound sales; H. A. Raymond, Jr. is manager of industrial sales; and C. O. Delaney is manager of coating resin sales. Robert K. White has been appointed advertising manager for Plaskon plastics and resins.

Permutit

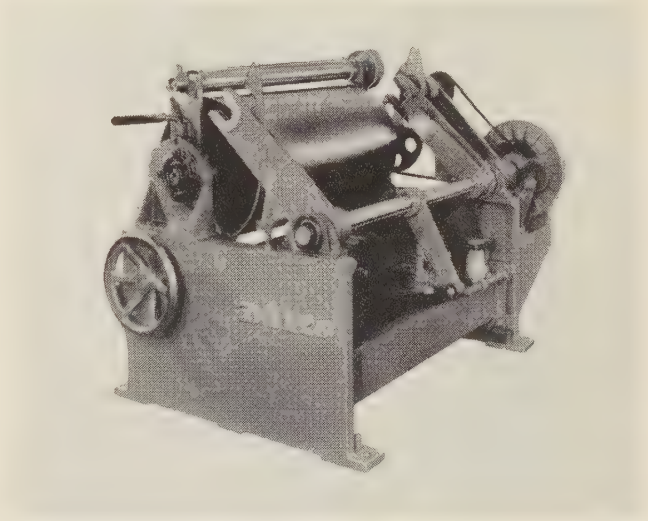
Felix W. Saco has been appointed development engineer of the Permutit Co., 330 W. 42nd St., New York, N. Y.

Dilts

Dilts Machine Works Div. of Black-Clawson Co., Fulton, N. Y., has announced a new Ferrisplice unwinder and a Surfastart winder. Designed principally for use on printing presses, bag machinery, and other processes running glassine, acetate, or cellophane, the new units are available in standard models for web widths from 20 to 40 in.



Ferrisplice winder



Surfastart winder—model SSW

Morningstar, Nicol

Morningstar, Nicol, Inc., Natural Gum Dept., 630 W. 51st St., New York, N. Y., has just issued a bulletin on the importation, processing, and usage of natural gum karaya.

Mico

Mico Instrument Co., 80 Trowbridge St., Cambridge, Mass. has published a leaflet describing the Mico fiber microtome for the rapid preparation of thin sections of fibers, threads, yarns, paper, etc., for microscopic examination.

SWIFT

E. R. Paul, general manager of Swift & Co., Adhesive Products Dept., Chicago, Ill., has announced the following personnel changes: C. S. Young will head the General Formulated Adhesive Products Div. in Chicago; H. A. Upton will be Pacific Coast sales manager in San Francisco; S. E. Carroll, Jr. was appointed Los Angeles plant head.

FOXBORO

The Foxboro Co., Foxboro, Mass., has issued a bulletin (No. 473) describing the Poweractor, a new force-release type positioner for cylinder-operated devices.

Foxboro's technical report TI 27-A-12a describes the Dynaformer Pressure Cell, a transducer for converting fluid pressure to proportional a.c. voltage.

Foxboro has opened a branch office at 1117 La Paloma St., Amarillo, Tex., in charge of D. T. McElligott, formerly of Foxboro's Dallas office.

HERCULES

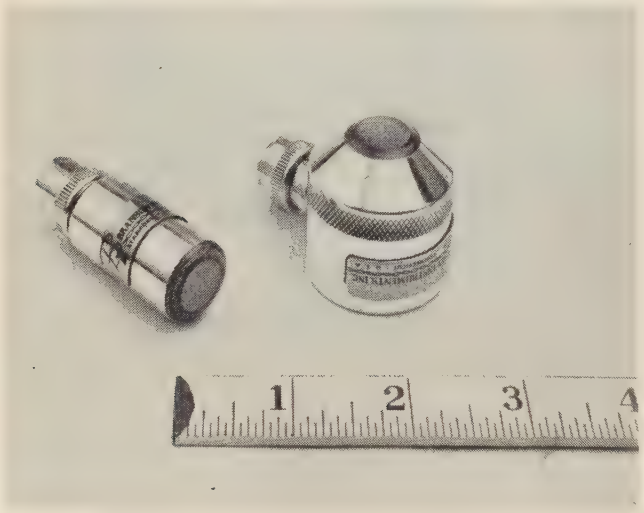
Hercules Powder Co., Wilmington, Del., has published a booklet, "Protection with Parlon," giving information on the use of chlorinated rubber-based coatings.

Hercules has announced a new rosin amine sales and development group under Emile Pragoff, Jr. Charles Moss is being transferred from the Wilmington technical service group to the New York territory as a technical sales representative. Fred Donovan is moving from technical sales work in the New York territory to a similar position in the San Francisco office territory.

A new sales office in Atlanta, Ga., will handle Hercules synthetic resins in the Southeast, under Charles S. Huhn, technical sales representative.

BRANSON

Branson Instruments, Inc., 430 Fairfield Ave., Stamford, Conn., has announced a new series of $^1/_2$-in. diameter high-sensitivity ultrasonic probes, designated Type B Transducers,

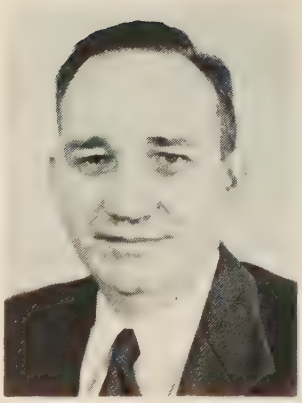


Branson Type B Transducers

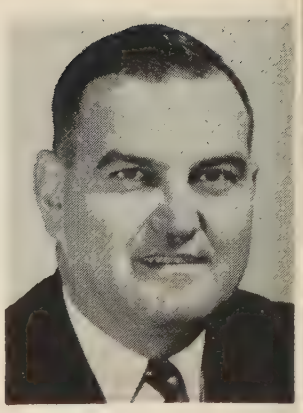
for use with the Audigage on metal of sharply tapering section, compound curvatures, and other unusual conformations.

CONTAINER

Charles J. Zusi, president of Container Laboratories, Inc., has announced the following appointments: Gordon S. Austin has joined the firm's engineering staff in Washington, D. C., James S. Hardigg and Ray F. Gochnour have also joined the Washington office, which is headed by Thomas P. Wharton, former chief of packaging for the Army General Staff.



C. S. Young, Swift & Co.



R. W. Keller, F. C. Huyck & Sons

ATLAS

Atlas Mineral Products Co., Mertztown, Pa., has issued a binder containing 78 pages of information on the use of plastics in preventing corrosion in the pulp and paper industry. Included are technical bulletins, reprints of published papers, drawings, and data sheets on the corrosion resistance of various plastics.

MONSANTO

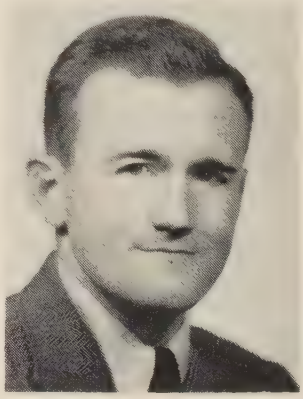
Monsanto Chemical Co., St. Louis 4, Mo., has announced a new low-cost, extender type plasticizer for vinyls, designated HB-20. The new material is described in Monsanto's technical bulletin P-153.

Robert K. Mueller, general manager of Monsanto's plastic division, has announced that construction is under way at the Texas City, Tex., site for the company's first polyethylene production plant. Production is expected to start during the third quarter of 1954.

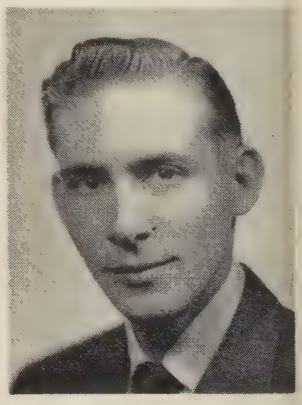
HUYCKFELT

Roy W. Keller has been appointed West Coast sales representative of F. C. Huyck & Sons, Rensselaer, N. Y. Mr. Keller will assume his new position Jan. 1, 1954, following termination of the Pacific Coast Supply Co.'s sales agency for pulp and paper mill supplies. Mr. Keller has been manager of Pacific Coast Supply Co.'s San Francisco office since 1950.

Huyck's field service engineering staff has been expanded through the recent addition of Russel A. Jensen and Albert E. Gedman, both of whom are now receiving training at Rensselaer.



A. E. Gedman, F. C. Huyck & Sons



R. A. Jensen, F. C. Huyck & Sons

Brown Instruments

Minneapolis-Honeywell Regulator Co.'s industrial division, Philadelphia, Pa., has announced schedules for industrial instruments maintenance and repair courses for the first half of 1954.

Witco

Witco Chemical Co., 260 Madison Ave., New York, N. Y., has published a technical service report (P-19) announcing the manufacture of cobalt hydrate.

& W

William J. Thomas, general manager of the Tubular Products Div., Babcock and Wilcox Co., Beaver Falls, Pa., has announced the appointment of James S. Anderson as general sales manager of the division. Robert E. Halloran has been appointed manager of mechanical sales.

Eichhold

Ralph T. Urich has been named general manager of the New England division of Reichhold Chemicals, Inc., 509 Madison Ave., New York, N. Y. The New England division headquarters are in Ballardvale, Mass.

Rust

The Rust Engineering Co., Pittsburgh, Pa., has published an illustrated booklet describing the growth of the company and illustrating many of the design and construction projects it has executed.

Jackson & Church

Jackson & Church Co., Saginaw, Mich., has issued a leaflet describing the 015 Roto-Pulper.

Spraying Systems

Spraying Systems Co., 3201 Randolph St., Bellwood, Ill., announces a 48-page reference catalog No. 24 of industrial spray nozzles.

Magnus

Magnus Chemical Co., Inc., Garwood, N. J., announces the appointment as vice-presidents of Roy D. King and Marcel Zinty. Mr. King will take charge of railroad sales and developments, and Mr. Zinty becomes general manager of the equipment division.

G.E.

General Electric Co., Schenectady 5, N. Y., has issued a bulletin (GEA-5873) describing synchronous motors, their operation and control.

G.E. has announced a new totally enclosed unit-cooled d.c. motor, available in ratings from 15 to 200 hp., featuring 50% greater heat transfer in a 37% smaller unit than previous designs.

Two new photoelectric relays featuring higher contact ratings, improved circuit design, and a full line of enclosures are now offered by G.E.'s Specialty Control Dept.

Bulletin GEA-5560 describes and illustrates installations of G.E. drives for paper finishing and converting.

Bulletin GEC-449B gives information on the general-purpose oscillograph, Type PM-10, and lists other instruments for industrial and central station use.

A G.E. publication, GEA-5409, explains the Limitamp coordinated control system.

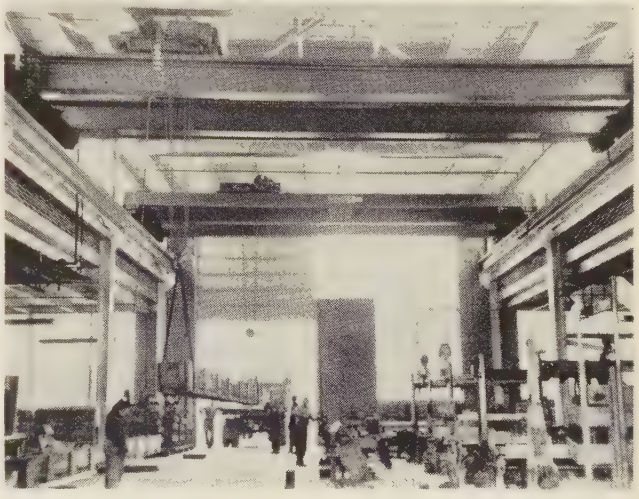
Also announced by G.E. is a new line of speed-variator slide-carriage drives, available in ratings of $7^1/_2$, 15, 20 and 30 hp. for 220 or 440-v. power supplies.

G.E.'s Special Products Section has announced a vibration detector for measuring vibration acceleration up to 50 g's in large rotating apparatus.

Cameron

Cameron Machine Co., Brooklyn, N. Y., has started production in its Dover, N. J., plant. Slitting and winding machines for finishing and converting are being manufactured and assembled at the new location, which comprises 42,000 sq. ft. of floor space on a 25-acre site.

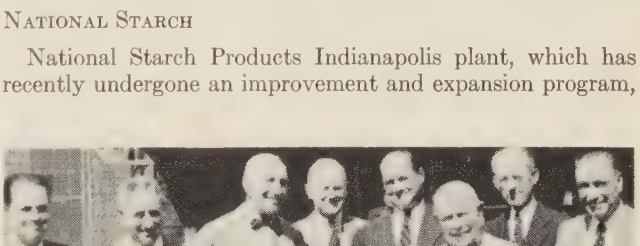
Cameron's new Dover plant, erected by the Hull Construction Co., Union, N. J., is located on a 25-acre site allowing room for contemplated expansion. The wing, jutting to the left, is the section occupied by the engineering division



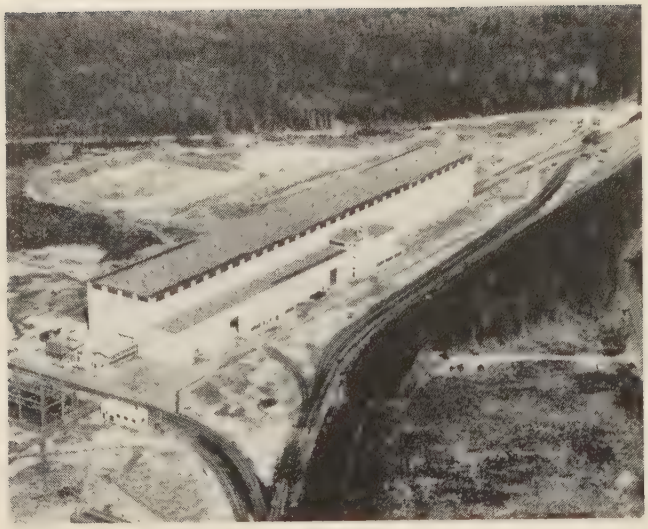
The two ten-ton cranes, running the entire length of the high center bay, are shown here being used to load a crated roll for a paper machine winder

National Starch

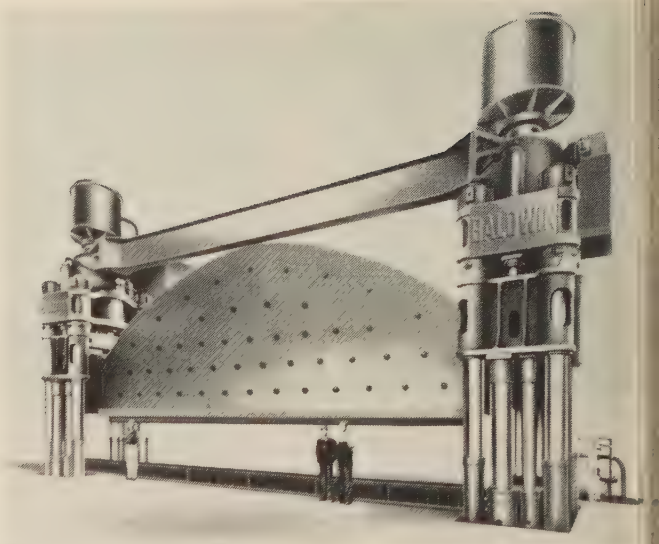
National Starch Products Indianapolis plant, which has recently undergone an improvement and expansion program, was inspected recently by a group of the company's directors and management.



National Starch group inspects company's plant. Left to right: Edward Conway, Frank Greenwall, Chester Gage, Evans Woolen, Jr., Bernard Schulist, Herb Piel, William Schiliges, and A. A. Halden



The new $5 million Foster Wheeler fabricating plant at Mountaintop, Pa., showing the nearly-completed plant as it appeared Nov. 4, 1953, when this aerial photograph was taken



The 8000-ton hydraulic beam press, one of the world's largest, is capable of bending steel plate 8 in. thick. It will be used in fabricating some of the largest and heaviest pressure vessels at the new Mountaintop, Pa., plant of Foster Wheeler Corp.

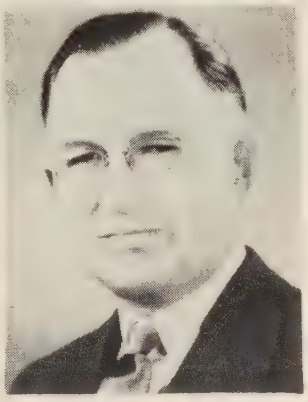
RAYBESTOS-MANHATTAN

S. V. V. Hoffman has been appointed manager of the west coast sales district of Raybestos-Manhattan, Inc., Passaic, N. J.

ROSS

At its annual 25 Year Club dinner recently, J. O. Ross Engineering Corp. welcomed 5 new members to the club.

J. O. Ross, J. O. Ross Engineering Corp.



S. W. Fletcher, J. O. Ross Engineering Corp.

The new members were presented with gold watches and greetings were extended by J. O. Ross, chairman of the board, and S. W. Fletcher, president.

HOOKER

Hooker Electrochemical Co. announces that it will start shipping liquid caustic soda and liquid chlorine from its new plant in Montague, Mich., starting Jan. 1, 1954.

FISCHER & PORTER

Fischer & Porter Co., Hatboro, Pa., has announced a Special Products division for the development of special instruments and instrument components to contract specifications.

WALDRON

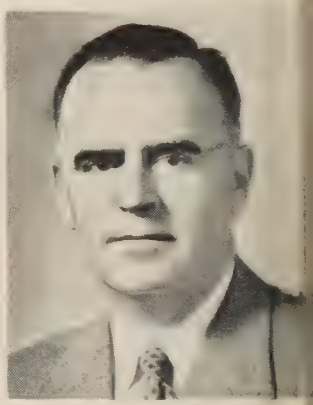
John Waldron Corp., Box 791, New Brunswick, N. J., has issued a bulletin (No. 1009) describing Waldron high-speed laminators.

GENERAL MILLS

General Mills, Inc., Minneapolis 13, Minn., has more than doubled the floor space of its O-CEL-O cellulose sponge plant near Buffalo, N. Y.

NOPCO

Thomas A. Printon, president of Nopco Chemical Co. Harrison, N. J., has announced the appointment of Robert F. McLellan as vice-president and general manager of Yocum Faust, Ltd., London, Ont., subsidiary.



R. F. McLellan, Yocum Faust, Ltd.

A. C. & D.

O. M. Morgan, assistant domestic sales manager, National Aniline Div., Allied Chemical & Dye Corp., New York, N. Y., has announced the appointment of Leon W. Seigle and Fred B. Johnson as manager and assistant manager, respectively, of the division's intermediate sales.

PENNSALT

Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa., is offering a chlorine dioxide generation and bleaching system to the pulp and paper industry. Consisting of one line steel tank, the generator can be housed in the existing buildings of most bleach plants.

GENERAL DYESTUFF

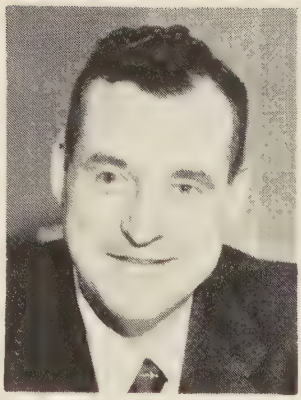
Lawrence S. Thomson has been appointed manager, Dyestuff Technical Dept., of the General Dyestuff Corp, replacing D. E. Marnon, who has resigned, it has been announced by S. H. Williams, vice-president and general sales manager.

COURTAULDS

Courtaulds, Inc., New York, N. Y., former owner of American Viscose Corp., has again entered the rayon production field in this country, with the opening of the Courtaulds (Alabama), Inc., plant at Le Moyne, Ala. Completed in 1952, the plant covers approximately 100 acres of a 500-acre site. Consisting of six main buildings with a floor space of 297,110 sq. ft., the plant includes a kitchen and cafeteria as well as a modern, fully equipped hospital.

V. C. Thomson, The Torrington Co.

R. B. Nichols, The Torrington Co.



J. B. Bonny, H. K. Ferguson Co.

O. F. Sieder, H. K. Ferguson Co.

ICE BARTON

The importance of paper in your daily life was the theme of he Rice Barton exhibit at the recent Worcester Industrial xposition attended by over 65,000 people. The exhibit onsisted of a Rice Barton miniature paper machine, loaned

them by the Franklin Institute of Philadelphia, Pa., and a splay of paper products emphasizing the many necessities life which are manufactured from paper.

The importance of the paper industry to our national economy was pointed out to the visitors and many were most surprised to learn that the industry is the sixth most important in the nation.

The paper machine at the Rice-Barton exhibit

FERGUSON

J. B. Bonny has been elected chairman of the board of the H. K. Ferguson Co., Cleveland, Ohio. Succeeding Mr. Bonny as president of the company is O. F. Sieder, formerly executive vice-president and general manager.

TORRINGTON

Walter C. Thomson has been elected president of the Torrington Co., Torrington, Conn., succeeding Lester J. Ross who died Nov. 14 last, and Ray B. Nichols has been elected executive vice-president, to succeed Mr. Thomson. N. Russell Clarke, president of the Westfield Mfg. Co., Westfield, Mass., a subsidiary, has been elected director for the unexpired term of Mr. Ross. Byron T. Virtue, chief engineer of Torrington's Bearings Div., has been promoted to general sales manager.

The 25th Anniversary of Leonard T. Beale, chairman of the board of the Pennsylvania Salt Mamnufacturing Co., (seated, second from left) was observed recently at a luncheon attended by company executives. Here President George B. Beitzel (seated, second from right) presents Mr. Beale his certificate of membership in Pennsalt's Diamond Keystone Club. Others are: Seated, left, Paul Kendall, president, Sharples Chemicals Inc., a Pennsalt subsidiary; and right, W. F. Mitchell, Pennsalt vice president in charge of manufacturing. Standing, left to right: W. A. LaLande, manager of research and development; G. T. Collins, Assistant to the president; E. F. Beale, treasurer; L. H. Clark, executive vice president, Sharples Chemicals Inc.; R. L. Davies, president, Pennsalt International Corp.; and F. C. Abbott, Pennsalt manager of personnel

OBITUARIES

Werner Kaufmann

Werner Kaufmann, formerly president and general manager of Kupfer Bros. Co., New York, N. Y., died of heart failure in the Mound Park Hospital, St. Petersburg, Fla., on Nov. 10, 1953.

Dr. Kaufmann was born in New York City on Dec. 23, 1905, and received his doctorate in chemical engineering and engineering chemistry from the Swiss Federal Institute of Technology in 1931.

Werner Kaufmann

Following graduation he joined his family firm which had mills in Europe and at Northbridge, Mass., as mill manager and vice-president. In 1950 Dr. Kaufmann retired from Kupfer Bros. Co. and for a short period conducted the sales activities of the Kupfer Bros. Paper Co. in Chicago. Frequent heart attacks forced him to retire permanently and to locate in Great Neck, N. Y.

Dr. Kaufmann was active in the Technical Association of the Pulp and Paper Industry as a member of its Executive Committee and chairman of the TAPPI Coating Committee and Local Sections Committee and general chairman of the TAPPI Industrial Division. As chairman of the Coating Committee he was the principal factor in the preparation of the outstanding TAPPI monographs on paper coating details.

He is survived by a son, Bert Kaufmann Barton, a daughter, Mrs. Joan Grant, his mother, Mrs. Tillie Kaufmann, and a sister, Mrs. Helen Stanton.

His remains were interred at the Fresh Pond Crematorium, Midland Village, L. I., N. Y.

Harold A. Morrison

Harold A. Morrison, consultant for Oliver-United Filters, Inc., died suddenly while on the golf course near his home in Pelham Manor, N. Y., on Nov., 14, 1953.

Mr. Morrison was born at Fort Bidwell, Calif., on Nov. 1, 1881, and graduated as a mining engineer from the University of California in 1904.

Prior to joining the Oliver-United Filters, Inc., 36 years ago, he was employed by the Seal of Gold Mining Co., Red Cloud Mining, Co., Horseshoe Mining Co., Gold Field Daisy Mining Co., Uwana Mining Co., Globe Consolidated Mining Co., and the Silver Dyke Mining Co.

Mr. Morrison became a member of the Technical Association of the Pulp and Paper Industry in 1921.

Per August Sture Andre

Sture André, managing director of Stromsnas Bruks A/B, Stromsnasbruk, Sweden, died at his home on Nov. 5, 1953.

Mr. André, who joined TAPPI in 1949, was born in Hononsjo, Sweden, on June 10, 1895, and graduated as an electrical engineer from the Royal Technical University of Sweden in 1918.

Prior to becoming president of Stromsnas Bruks A/B in 1933 he was superintendent of Vasteras Kraftwerk from 1918 to 1921. From 1922 to 1931 he was president of SKF South America in Argentina and Brazil and in 1932 and 1933 he was associated with Ljungstrones Angturbin in Stockholm, Sweden.

LETTERS TO THE EDITOR

Paper-Plastics Research

To the Editor, *Tappi:*

The Plastics Committee of TAPPI is desirous of extending to paper manufacturers and converters who are using plastics and resins in their manufacture, an invitation to assist us in developing a program of suitable research in the field which will ultimately benefit the paper industry. We have one research project currently being sponsored by this committee entitled, "The Permeability of Plastic Films and Coated Papers to Water Vapor and Other Gases."

It is important for the members of the committee to recognize all the problems connected with this field of interest and we would like to have any suggestions members of TAPPI may care to make as to suitable research and development topics for possible sponsorship by this committee.

May we request your suggestions be sent to the undersigned at the College of Forestry, State University of New York, Syracuse 10, N. Y.

V. T. Stannett, *Secretary*
TAPPI Plastics Committee

Book and Magazine Exchange

To the Editor, *Tappi:*

At this time I would like to propose an initiate a project which I believe will be helpful in improving the library situation of the paper industry. If the project grows in magnitude perhaps TAPPI will wish eventually to make it a permanent service.

There must be many who have various sized collections of technical journals in the chemical and papermaking field that are of no further use to them and are merely gathering dust on some shelf or are in some attic deteriorating. If anyone wishing to dispose of such journals and books will write me stating the condition and list the material (carefully give name, volume, and number of each item), whether it is available for sale (state price) or gift for payment of freight, etc., I will cross list the material and its location so that interested college and industrial libraries can acquire it and put it to a useful purpose. It is proposed that industrial libraries receiving such material be those which allow use of their facilities to neighboring industry and other paper mills in the vicinity to a reasonable extent. In this way our whole industry will benefit.

Any magazines listed should be in good enough condition for binding with no pages badly marked or cut out. It is hoped that sufficient sets of technical magazines may be obtained to allow a trade with foreign groups for their excess magazines.

If anyone missing copies to complete their sets will advise me of their needs and list any magazines (chemical or papermaking field) they wish to trade, I can advise them as to what is available.

T. T. Collins, Jr.
P.O. Box 1620, Jacksonville, Fla.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Coating Committee

The Coating Committee held a meeting at TAPPI Headquarters in New York on Oct. 2, 1953, with the following present: Norman F. Kennedy, Joseph J. Thomas, Gordon I. Hoover, Harris O. Ware, J. D. Lohnes, R. McMahon, C. G. Landes, J. T. Loomer, F. H. Denham, H. E. Brakewood, R. N. Thompson, R. J. Jacobs, R. M. K. Cobb, W. R. Willets, A. Zettlemoyer, J. H. Heuer, R. T. Trelfa, chairman, A. D. Bonanno, secretary.

Plans were made for the next TAPPI Coating Conference, to be held at Poland Spring, Me., May 24 to 26, 1954. Joseph J. Thomas, S. D. Warren Co., Cumberland Mills, Me., has been appointed general chairman of this meeting. Mr. Thomas already has the program well in hand, and is planning the presentation of five general papers on topics of interest to coating mills, as well as nine or more papers on specific subjects in the coating field.

Tentative program for the Coating Conference is as follows:

General Topics:

J. Swanson, Institute of Paper Chemistry—Film Splitting.
A. J. McAneny, Bradner, Smith, & Co.—Printing.
W. R. Willets, Titanium Pigments Corp.—to be announced.
K. A. Arnold, St. Regis Paper Co.—to be announced.
G. I. Hoover, Provincial Paper Co.—to be announced.
John Davis, Mead Corp.—to be announced.

Pigments:

R. N. Thompson, Calgon, Inc.—Satin White.
R. W. Hagemeyer, Wyandotte Chemicals Corp.—Calcium Carbonate.

Adhesives:

H. R. Hall, Allied Paper Mills—Isolated Soy Bean Protein.
C. Kesler, Penick & Ford, Co.—Starch.

Equipment:

R. J. Jacobs, Dilts Machine Works—Modification of the Waxing Machine for Coating Paper in Various Ways.
F. H. Frost, S. D. Warren Co.—The Printing Wedge.

Raw Stock:

A. M. L. Cushing, Stein, Hall & Co.—Natural Gums for Better Coating Stock.

Operations:

A. W. V. Torrey, S. D. Warren Co.—Foam in Coating Mixtures.

Anyone wishing to present a paper at this meeting should get in touch with TAPPI Headquarters, or with Mr. Thomas. Suggestions regarding the program will also be welcomed.

A meeting of the Coating Committee will be held at TAPPI Headquarters on Sunday, Feb. 14, 1954, at 2:30 p.m. A meeting open to the membership at large will be held as usual on the Monday afternoon of the Annual Meeting (Monday Feb. 15, 1954).

Monograph No. 11 on the Preparation of Coating Colors is at the press and will be published soon. The revision of the Starch Monograph, under J. P. Casey, A. E. Staley Co., is in progress under the following authors: F. H. Frost, R. W. Kerr, T. Shoch, A. White, L. Gussman, J. Newton, C. C. Kesler, C. G. Caldwell, Fred Denham, H. C. Schwalbe, K. M. Gaver, Monroe Mason, Lloyd Silvernail, J. E. Sullivan, F. Kaulakis, Jr., J. T. Loomer, D. D. Ritson, Fred Culp, J. E. Ward, J. Wilbur, W. C. Black, and N. F. Kennedy.

Electrical Engineering Committee

The following members of the Electrical Engineering Committee attended the 1953 Montreal meeting:

R. R. Baker
D. E. Bivins
Ray Chermak
N. L. Danforth
E. F. Greive
J. L. Grady
R. W. Foster
A. O. Mortenson
M. J. Osborne
R. F. Sorenson
J. L. Van Nort
I. Witham

GENERAL SESSION

The General Session of the Electrical Engineering Committee was on Monday, Oct. 26, from 2 to 3:45 p.m.

Messrs. Hobbs and Kaufmann presented their paper on "Grounded versus Ungrounded Power Systems," and Mr. Sorenson gave his report on "An Engineering Analysis of Down Time of Electrical Sectional Drives."

There were about 225 people present.

In the discussion following the paper on "Grounding," John Eyton of Abitibi Pulp and Paper Co., stated that Canadian mills have not had much difficulty running ungrounded in general. He agreed that dangerous overvoltages could occur but only four times in his experience had there been multiple failures. He indicated that most faults were the result of cable insulation breakdowns which very quickly become solid grounds rather than arcing grounds. He is now installing two substations with grounding to test its usefulness, but disconnect switches will be provided so the grounding may be removed if desirable. Mr. Eyton mentioned that the Allen ground detector was very effective in locating ground faults to keep an ungrounded system free from unintentional grounds.

Mr. Hobbs commented on Mr. Eyton's remarks by stating that his experience was quite different and that he had decided to ground because of the many difficulties encountered at Bowaters when operating ungrounded.

G. P. Hobbs, Bowaters Newfoundland Pulp & Paper Mills, Ltd.

R. H. Kaufmann, General Electric Co.

Mr. Crawford of the Continental Paper Co. stated that high-voltage grounding was quite feasible, but that he preferred delta-connected secondary on low-voltage transformers so that he could operate open-delta in case of a failure.

Mr. Kaufman replied that while open-delta was useful for continuity of service, the trend was toward three-phase transformers because of installation convenience and savings in space. Transformer failures are almost rare and the use of two substations with a normally open tie breaker in a secondary selective arrangement assures continuity of service in case one substation fails. Mr. Kaufmann gave as an example a 1500-kva. substation. If this consisted of three 500-kva. single-phase transformers, it would be good for 870 kva. (58%) in open-delta. If two 750-kva. three-phase transformers were used in a secondary selective arrangement, 750 kva. would still be available in case of a failure of one of the transformers. The latter scheme not only provides almost as much capacity in case of transformer failure as open-delta, but also protects against the contingency of a primary cable failure which is much more likely.

The discussion after Mr. Sorenson's paper on "Down Time of Sectional Drives" was as follows:

Mr. Kennedy of Hammermill Paper Co. asked Mr. Sorenson if setting up the record program or getting better maintenance was more effective in reducing down time. Mr. Sorenson replied that both went hand-in-hand and the keeping of records had helped the maintenance program greatly.

Mr. Laverty of the Anglo Canadian Pulp and Paper mills asked Mr. Sorenson if some of the gain in the reduction of electrical down time was not the result of his shunting it to other departments and also if the over-all down time was reduced. He further commented that the amount of down time per machine per month seemed high.

Mr. Sorenson replied that some of the down time, of course, had been transferred to other departments, but this had the advantage of fixing responsibility for it so that steps could be taken for its improvement and that the over-all down time had been reduced. He further said that his paper machines were averaging 2 hr. per month electrical down time based on careful records, which are not being kept in many cases. He said that in his opinion, speed was a major factor and that his paper machines were operating at top speeds for the weights being made, so that the sectional drives had to be at peak performance all of the time. In addition, Union Bag is running 7 days a week with only four major shutdowns per year so there is no opportunity for Sunday maintenance as is the case in the Canadian mills.

Round-Table Meeting

The round-table meeting of the Electrical Committee was held immediately after the General Session from 3:45 to 5:30 p.m. There were about 150 people present.

Electrical Engineering Committee luncheon

Mr. Osborne presented a review of the work to date which has been done by his Chipper Subcommittee for the benefit of the over-all Electrical Committee and other people present at the round-table session.

He called attention to the omission from the chipper questionnaire of a question on whether or not a chipper-driven blower for handling chips was in use. Since the blower horsepower can be as much as 150, it is essential that this additional information be uncovered and the Chipper Committee is going to take steps to do this.

Mr. Osborne appointed Messrs. Barrows and Wardwell to investigate why the energy requirements for chipping increase substantially as the idle time on the chipper increases.

Mr. Osborne then introduced Mr. Baker who presented his report on the energy for chipping in the form of a written memorandum dated Oct. 26, 1953. Copies were distributed to many of those present.

Mr. Osborne then introduced Mr. Shaad who presented his report on the determination of motor size, using the known constants of the chipper installation including the energy requirements. The method proposed by Mr. Shaad makes use of a nomograph for synchronous motors and a nomograph for induction motors. Copies of the nomograph with an accompanying explanation, dated Oct. 1, 1953, were distributed.

Mr. Osborne then read a letter from G. L. Oscarson dated Oct. 19, 1953. Mr. Osborne also stated that the reports from Messrs. Baker and Shaad represented individual proposals, and had not as yet been considered by the Chipper Subcommittee.

Mr. Wardwell of the Carthage Machine Co. asked Mr. Shaad why the nomograph used the ratio of average diameter over maximum diameter, instead of the squares of each. Mr. Shaad replied that the use of a log function scale permitted this simplification.

Mr. Shaad then commented on Mr. Oscarson's letter stating that he felt the nomograph does more than a formula since it is possible to work in the feed rate for the chipper. He further stated that while the formula solution for the size of a synchronous motor was simple, it would be much more difficult for the induction motor and the nomograph was better.

Mr. Shaad said that he questioned the 1.2 to 1 safety factor used by Mr. Oscarson for the energy requirements of a particular species. He stated that he would recommend 1.3 to 1 because of the variations from log to log. He also questioned Mr. Oscarson's use of 25% of the maximum power to arrive at the continuous rating of an induction motor.

Mr. Barrow asked Mr. Osborne what the questionnaire meant by the term "maximum cords." Mr. Osborne replied that it was the maximum production for 1 hr. and stated that the committee wanted to know the spread from actual maximum to theoretical to see how much of the chipper capacity actually could be used. He stated that in most cases this ratio of maximum cords per hour to theoretical chipper capacity was around 16% except Southland which was about 46½%. Mr. Drew of Southland responded that the 46½% figure was the maximum he had and he had since reviewed his figures for 1952 and 1953 and had come up with a ratio of average to theoretical maximum production which varied from 26.5 to 30%. He stated that he was running a four-knife chipper at 257 r.p.m. This looked slower and perhaps that accounted for it.

Mr. Osborne asked Mr. Drew if he had a variable speed drive on the log conveyor to the chipper, suggesting that perhaps that accounted for the high ratio. Mr. Drew stated that he did have such a drive and that the operator tried to keep the spout full.

Mr. Osborne closed the round table on chippers by stating that it was the subcommittee's intention to provide mill people with all the tools they needed to select chipper drives using formulas, nomographs, etc., and publish such information in TAPPI Data Sheets.

The round-table discussion on the report of the Cable Committee was then introduced by Mr. Mortenson, its chairman. Mr. Mortenson stated that all Electrical Committee members have the report and that it has been published in *Tappi*. He hoped that the Electrical Committee when it met at its luncheon meeting the following day would consider the report final. There have been no comments on the report since its publication and the Subcommittee therefore assumed that it was satisfactory. Mr. Mortenson then presented the final report and acknowledged the Committee's indebtedness to the International Power Cable Engineers Association, and, in particular, E. W. Davis, its president.

The meeting was then turned back to Mr. Foster by Mr. Mortenson. Mr. Foster thanked Mr. Mortenson and his committee for doing an outstanding job and stated that the report would be a great help to the members of the industry. Mr. Foster asked Mr. Davis if he had any comments to make. Mr. Davis stated that there were no specifications by the cable industry as yet for the cable given as type 3 in the report but that these were in process. He also stated that there were no standardized cable specifications yet for mineral installation.

He stated that the specifications were not intended to include control cable but power cable only and that some trouble had been encountered in d.c. service with thin-walled control cable. Test investigations of this are now being made by cable manufacturers.

Mr. Davis urged that the Cable Subcommittee of TAPPI continue its work so that our cable recommendations can be kept up to date with new developments.

Mr. Osborne asked Mr. Davis about microbiological deterioration of Neoprene jackets in cases of direct burial. Mr. Davis said in reply that he was speaking only for his company and such deterioration has been suspected and confirmed in the laboratory. Many cable manufacturers are putting retarding agents in their Neoprene jackets, he stated, and considerable research work is taking place on the problem. Such deterioration requires high humidity and high temperature.

Electrical Engineering Committee

The committee luncheon was held on Tuesday, October 27, at 12:30 p.m., at the Sheraton-Mount Royal Hotel, Montreal, Que. The following people were in attendance:

Ray W. Foster, Champion Paper & Fibre Co.*
Jack Winchester, TAPPI, New York
Dan E. Bivins, Brown Paper Mill Co.*
I. Witham, Byron Weston Co.*
Ray Chermak, Kalamazoo Vegetable Parchment Co.*
R. R. Baker, Westinghouse Electric Corp.*
R. F. Sorenson, Union Bag & Paper Corp.*
J. L. Grady, Oxford Paper Co.*
N. L. Danforth, St. Regis Paper Co.*
E. F. Greive, Allis-Chalmers Mfg. Co.*
H. F. Biggau, Reliance Electric & Engineering Co.
M. M. Stokely, J. E. Sirrine Co.
S. A. Bobe, Westinghouse Electric Corp.
M. J. Osborne, Bowaters Southern Paper Corp.*
G. W. Knapp, General Electric Co.*
A. O. Mortenson, St. Regis Paper Co.*

*Committee Members.

Chairmen and secretaries of the Engineering Division Committees, l to r seated: C. A. Young, Riegel Paper Corp., Chairman, Heating and Ventilating Committee; K. O. Elderkin, Bowaters Southern Paper Mills, Vice-President, TAPPI; H. F. Parker, New York & Pennsylvania Co., retiring chairman, Mill Maintenance and Materials Committee; S. M. Bratton, Pusey & Jones Corp.; R. A. Packard, Chairman, Planning and Economics Committee; C. J. Sibler, West Virginia Pulp & Paper Co., General Chairman; W. C. Bloomquist, General Electric Co., General Secretary; J. Gottlieb, Westinghouse Electric Corp., Secretary, Steam and Power Committee; J. A. Winchester and R. G. Macdonald, TAPPI. Standing: J. W. Hemphill, Johns-Manville Corp., Chairman, Data Sheets Committee; R. W. Foster, Champion Paper & Fibre Corp., Chairman, Electrical Engineering Committee; H. G. Ingraham, Chas. T. Main Inc., Chairman, Methods of Estimating Costs of Engineering Projects Subcommittee; A. M. Hurter, Stadler, Hurter & Co.; G. F. Hrubecky, Marathon Corp., Chairman, Mill Maintenance and Materials Committee; W. R. McNally, Link-Belt Co., Chairman, Materials Handling Committee; H. A. Stoess, Jr., Fuller Co., Secretary, Materials Handling Committee; J. R. Lientz, Union Bag & Paper Corp., Chairman, Chemical Engineering Committee; R. G. Quinn, Johns-Manville Corp., Chairman, Engineering Research and Machine Design Committee; R. D. Irwin, Minneapolis-Honeywell Regulator Co., Secretary, Engineering Research and Machine Design Committee; W. M. Wyburn, Federal Paper Board Co., Chairman, Steam and Power Committee; G. W. Knapp, General Electric Co.; K. W. Mackenzie, Eastman Kodak Co., Chairman, Hydraulics Committee; H. O. Teeple, International Nickel Co., Secretary, Chemical Engineering Committee; and J. D. Lyall, Armstrong Cork Co., Assistant General Chairman

The following committee members were absent:

J. L. Van Nort, Reliance Electric & Engineering Co.
T. E. Digby, Container Corp. of America
T. Foulkes, E. B. Eddy Co.
A. S. Goodrich, Hammermill Paper Co.
M. Strain, Continental Paper Co.
H. C. Swannell, J. E. Sirrine Co.

The results of the questionnaire set out by the secretary were reported and the following program was agreed upon for the 1954 Philadelphia meeting.

General Session:

"Application and Design Characteristics of A.C. Motor Control" (Project 434), R. W. Foster.
"The Selection of Chipper Drives" (Project 433), M. J. Osborne.

Round Table:

"Power Requirements of Supercalenders" (Project 368), J. L. Van Nort.
"Results of Down-Time Investigation of Electrical Drives" (Project 435), R. F. Sorenson.

The Electrical Engineering Committee then discussed the excellent work done by Mr. Mortenson and the Cable Subcommittee for the past 3 years and asked Mr. Mortenson if he would continue this subcommittee so that new cable developments could be included in committee's recommendations as they become available. Mr. Mortenson agreed to do this.

Mr. Mortenson will write to Mr. Winchester of TAPPI Headquarters on the information to be included from the cable report for making it up as TAPPI Data Sheets.

The Electrical Engineering Committee will sponsor a paper for publication in *Tappi* on corrosion tests of various metals in pulp mill atmospheres. These were made by the General Electric Co. to determine the suitability of such metals for cable armor and fittings, particularly, but also give information which is generally useful. The paper will be written by B. J. Mulvey, Wire and Cable Dept., and J. F. Quinlan, Schenectady Works Laboratory, General Electric Co. It will be a technical report and will be circulated within the Electrical Engineering Committee before publication.

Mr. Baker agreed to submit his report on the "Power Requirements of Press Sections" in data sheet form to Mr. Winchester.

A. C. Cook, General Electric Co., will continue with his investigation of the Power Requirements of Drier Sections. Mr. Cook has prepared a questionnaire which was held up because of the lack of a suitable mailing list of sectional drive users. The Electrical Engineering Committee will request General Electric Co., Reliance, and Westinghouse, as the major electrical drive manufacturers, to exchange lists of their installations so that a mailing list can be established. Mr. Baker agreed to prepare a report on the Power Requirements of Calender Sections and will circulate a questionnaire within the Electrical Engineering Committee to get it started. He will then use the same mailing list of sectional drive users for its distribution.

Mr. Chermak accepted the appointment as chairman of the subcommittee which will study the location and causes of motor failures and investigate maintenance on motors. This will constitute a new project and a project number will be obtained from TAPPI Headquarters.

It was decided that the reports on Power Requirements of Paper Machines would not be given before future engineering conferences but would be published in *Tappi* and written as data sheets following circulation and approval of the Electrical Engineering Committee.

Mr. Knapp resigned as secretary and Mr. Van Nort was appointed in his place.

The Data Sheets Committee requested the Electrical Engineering Committee to appoint a representative to serve on the Data Sheets Committee and work within the Electrical Engineering Committee to get out Data Sheets. Mr. Knapp accepted this appointment from Mr. Foster.

G. W. Knapp, *Secretary*

Engineering Research and Machine Design Committee

The regular Fall meeting of the Engineering Research and Machine Design Committee was called to order at the Sheraton-Mount Royal Hotel, Montreal, Que., at 1:30 p.m. on Tuesday, Oct. 26, 1953, by resigning chairman, John Lyall. After a brief review of Monday's activities he introduced the new chairman, Robert G. Quinn, who presided over the meeting.

A. Reports of the subcommittee.

1. Constant Tension Devices—George Ehemann, chairman.

   It was moved that the presentation of the fine paper on Monday, October 26, entitled, "Paper Tension Regulators," by G. C. Ehemann and R. C. Berger fulfilled the requirements of this subcommittee, which was dissolved with our thanks for a job well done.

2. Rubber Roll Committee—K. W. Brenner, chairman.

   A suggested method on the use of the plastometer for measuring roll hardness has been published in *Tappi*. It is planned to study the performance of an air-loaded plain press and, if possible, to determine the effect of roll hardness on water removal. Studies have been made on the performance on a press with a preheated sheet. The result of these studies will be tabulated and studied.

3. Methods of Estimating Cost of Engineering Projects —H. G. Ingraham, chairman.

   At the meeting in New York in February, we reported that the work of our subcommittee had fallen into the pattern of a one-man job, at my own suggestion. During the past year some effort has been expended on committee work but we have very little to show for it. I have tried to determine if there was available, in printed form, sufficient useful information on costs and cost estimating which could be reprinted in *Tappi* and eventually form the nucleus of a booklet of reprints for distribution to those interested.

   Some members of the Engineering Committees of TAPPI have been very helpful in spotting and reporting to me articles in various publications dealing

Engineering Research and Machine Design Committee luncheon

with the subject of costs and cost estimating. I have carefully read the small number of them we have been able to locate but, with very few exceptions, the articles dealt with costs of installations in other industries or the information was, in my opinion, unsuited for the purposes intended.

The first two articles our committee had published appeared in the October 1952, issue of *Tappi*. Both articles dealt with pipe cost estimation. We had a number of compliments on the high quality of the material submitted and requests for reprints.

The second two articles appeared in the July, 1953, issue of *Tappi*. One article was on the cost of field-erected storage tanks and the other on the cost of recording, controlling, and indicating instruments, prepared by the Foxboro Co.

We have under consideration two or three others. The point I wish to make is that the right kind of information, if any is available, is hard to find. It takes too long to locate and arrange these articles for republication. In order to have a continuing string of cost information coming along, there should be a substantial backlog of information on which to draw.

This Subcommittee on Cost Estimation was appointed at the Fifth Engineering Conference of TAPPI in Cincinnati in October, 1950. At the time it was formed there was considerable difference of opinion among those present as to the ability of a subcommittee to work out something of real value to the paper industry. I agreed to accept the chairmanship of this committee on the condition that the work would be exploratory only to the extent of reporting to this Engineering Group at some future meeting if we thought it was a worth-while project and whether the subcommittee should be continued as a going project of the Engineering Research and Machine Design Committee.

I have come to the following conclusions: (a) the paper industry badly needs information to simplify preparation of preconstruction cost estimates. (b) Some information is available in the hands of mill engineers. (c) An organized publicity campaign plus personal contact would bring out some of this information. (d) Some mill engineer or college professor of one of the papermaking schools might be retained and paid by TAPPI to see what could be done along this line. (e) An entirely new approach must be made to this project. (f) The present subcommittee has served its purpose and should be dissolved as of this meeting.

At the request of the committee it has been dissolved, however, since this type of work is important Mr. Ingraham has been requested to investigate the possibility of establishing a new approach for this project. Mr. Ingraham will investigate the possibility of having this work done by some professional organization.

3. Project status report.

1. *Stock Control Systems*—Chairmanship transferred at Montreal meeting from Larry Moore formerly of American Coating and presently of Black-Clawson to Les J. Tarbell of Bird & Son. Moore to continue as member of committee and convey to Tarbell information previously gathered in order to consolidate plans for presentation of a paper one year hence and for consideration of the general plans of the committee by the Engineering Research and Machine Design Committee next February.
2. *Rubber Roll Committee*—W. Brenner reported publication of plastometer measuring device approved and published in *Tappi* with ensuing planned steps for further investigating roll diameters, hardnesses, thickness of covering, and loading for various sections of the wet end and will report on program at next February's meeting.
3. *Cost Estimating*—Harold Ingraham reported that he had so far obtained and published data regarding costs for piping installation but from this point on would require assistance of professional services and that he would present a program recommending such in the near future.
4. *Machine Measurements*—George Clink not present but later contacted by project chairman who obtained Clink's agreement that he would endeavor to devise a method and prepare a questionnaire on the subject of felt tensions and wire tensions.
5. *Improved Design Practices for Lubricating Paper Machines*—To date, May of Bowser, Miller of Gulf, Spencer of Torrington Bearings, and Sippola of Socony-Vacuum have indicated their willingness to work on the committee but no mill man has yet been found to act as chairman. Miller agreed to endeavor to find a mill engineer who was willing to act as chairman and to recommend his appointment.
6. *Drier Bearing Friction Tests*—Data will be prepared in graph form by Larry Moore for release.
7. *Noise Abatement*—Regarded by group as eligible project. B. M. Hutchins of the Rust Engineering Co., Pittsburgh, Pa., was selected chairman.

Note 1: All project chairmen were requested to prepare a brief outline showing the objective and the scope of their projects as well as the plan for accomplishment with a copy to the project vice-chairman at their earliest convenience.

Note 2: In order that data can be collected for the noise abatement project each member that has data available that can be published is requested to send the information to B. M. Hutchins at the Rust Engineering Co., Pittsburgh, Pa.

C. Tentative papers for next year are: Cylinder Mold Exhaust Vacuum Requirements"; "Balancing of Machine Rolls"; "Noise Abatement."

The meeting was attended by the following:

R. D. Irwin, M-H Reg. Co., Philadelphia, Pa.
E. A. Crawford, Continental Paper Co., Ridgefield Park, N. J.
L. A. Moore, Black-Clawson, Hamilton, Ohio
K. W. Brenner, Eastman Kodak, Rochester, N. Y.
M. B. Newell, Ecusta Paper Corp., Pisgah Forest, N. C.
Dwight E. Jones, E. D. Jones & Sons Co., Pittsfield, Mass.
E. Sterling Skinner, Beloit Iron Works, Beloit, Wis.
R. C. Berger, General Electric, Cleveland, Ohio
J. P. Holloway, Armstrong Cork Co., Lancaster, Pa.
W. S. Miller, Gulf Oil Corp., Pittsburgh, Pa.
J. C. Harper, Downingtown Mfg. Co., Downingtown, Pa.
R. T. DePan, Sandy Hill Iron & Brass, Hudson Falls, N. Y.
Burleigh M. Hutchins, The Rust Engineering Co., Pittsburgh, Pa.
Harold G. Ingraham, Chas. T. Main, Inc., Boston, Mass.
Reijo Merikanto, Oulu Kraft Pulp Mill, Oulu, Finland
C. E. Macklem, Beloit Iron Works, Beloit, Wis.
Frank Sanger, Pusey & Jones Corp., Wilmington, Del.
G. C. Ehemann, Ohio Boxboard, Rittman, Ohio
L. J. Tarbell, Bird & Son, Inc., East Walpole, Mass.
J. R. Curtis, Scott Paper Co., Chester, Pa.
R. G. Quinn, Johns-Manville, Manville, N. J.
John D. Lyall, Armstrong Cork Co., Lancaster, Pa.
C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.
G. H. Spencer, Torrington Co., Torrington, Conn.

Drying and Ventilating Committee

The Drying and Ventilating Committee Luncheon was held at 12:30 p.m., October 26, in Salon C of the Sheraton-

The panel which led the discussion during the Drying and Ventilating Session

Mount Royal Hotel. The following persons were in attendance for the luncheon:

Curt A. Young, Riegel Paper Co.
F. A. Garret, Canadian International Paper Co.
A. E. Montgomery, J. O. Ross Corp.
R. M. Cook, Midwest-Fulton Machine Co.
Anthony Cirrito, Lukens Steel Co.
James M. McAlear, Mason-Neilan Regulator Co.
A. J. Smith, Midwest-Fulton Machine Co.
L. G. Janett, J. O. Ross Corp.
E. G. Drew, Drew Engineering Co.
R. G. Macdonald, TAPPI

Curt Young, the chairman, led the discussion after the luncheon, and the first business taken up was the reorganization of the committee membership to secure active and interested members in order to further future projects and developments as worked up by the committee.

The active membership of the committee is to consist of the following:

Curt A. Young, Chairman
R. M. Cook, Secretary
L. G. Janett
E. G. Drew
James M. McAlear
Anthony Cirrito
M. L. Barker

In order to set up subcommittees for programs, projects, and data, it was decided that more active members, particularly from paper mills, would have to be secured and the probable best way to secure these active members would be to contact management of various paper mills throughout the country, stating our requirements for active members of different committees and request that management of these various paper mills appoint an interested individual to serve on the various subcommittees of the Drying and Ventilating Committee.

A complete discussion was held upon the merits of approaching management of the various paper mills and it was agreed that in order to secure active participation of members, particularly when experiments may be required in the mill, that a cooperative management would help considerably in securing the data necessary for presentation through the Drying and Ventilating Committee at future TAPPI meetings.

During the general discussion which followed, it was tentatively agreed upon that a Project Committee should be set up with active members from paper mills to work on test data in securing a more accurate method of measuring surface temperature of driers and to study methods of measuring felt tension and moisture in the felts.

At the close of the meeting, A. E. Montgomery of J. O. Ross Corp. announced that he was retiring from active participation in business and would, therefore, not be available as a member of the committee. His retirement was accepted by the committee with the greatest of reluctance since he has been very active on the committee and has helped and guided its course through the past several years.

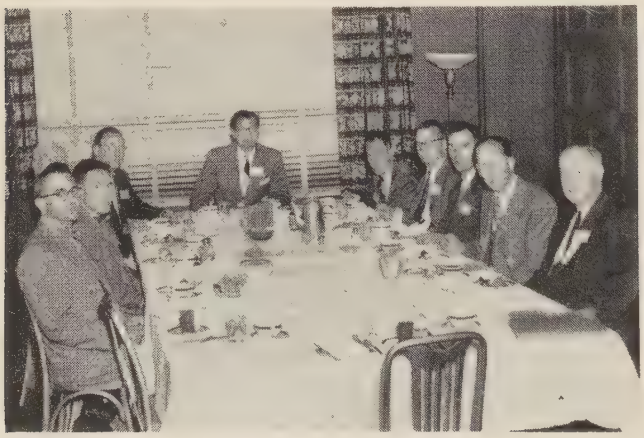
ROBERT M. COOK, *Secretary*

Data Sheets Committee

Following are the minutes of the meeting held at the Sheraton-Mount Royal Hotel on Oct. 28, 1953.

Present were:

R. G. Quinn, Johns-Manville, Manville, N. J.
W. H. Hall, Mead Corp., Chillicothe, Ohio
R. A. Packard, 8519 Garland Ave., Takoma Park, Md.
L. C. Jenness, University of Maine, Orono, Me.



Drying and Ventilating Committee luncheon

Data Sheet Committee luncheon

P. H. Nelson, Chas. T. Main, Inc.

W. Taylor-Bailey, Dominion Bridge Co., Ltd.

H. M. Canavan, Mutual Boiler & Machinery Insurance Co.

C. B. Christiansen, Pulp & Paper Research Institute of Canada

D. E. Jones, E. D. Jones & Sons, Pittsfield, Mass.
G. W. Knapp, General Electric Co., Schenectady, N. U.
C. A. Young, Riegel Paper Corp., Milford, N. J.
K. J. Mackenzie, Eastman Kodak Co., Rochester, N. Y.
A. I. Sippola, Socony-Vacuum, New York, N. Y.
H. F. Parker, New York & Pennsylvania Co., Lock Haven, Pa.
Geo. Hrubecky, Marathon Corp., Menasha, Wis.
J. W. Hemphill, Johns-Manville, New York, N. Y.
A. J. Winchester, TAPPI, New York, N. Y.

The Canadian Pulp and Paper Association Technical Section Engineering Data Sheets Committee had been invited to attend this meeting, and the following members were present:

P. N. Bowle-Evans, Canadian International Paper Co., Gatineau, Que.
A. M. Hurter, Stadler, Hurter & Co., Montreal, Que.
C. C. Church, E. B. Eddy Co., Hull, Que.
P. Remillard, Canadian International Paper Co., Gatineau, Que.
C. S. Sutherland, Ontario Paper Co., Thorold, Ont.
J. F. Frisch, Technical Sect. CPPA, Montreal, Que.
H. W. H. Jones, E. B. Eddy Co., Hull, Que.

The meeting was called to order at 2:15 p.m. by J. W. Hemphill, chairman.

After welcoming the members of the Canadian committee, Mr. Hemphill outlined the plans of this committee to produce a Pulp and Paper Mill Engineer's Handbook. Mr. Hemphill and Mr. Winchester had prepared a proposed outline for such a handbook, and this was used as a basis for discussing detailed plans as to the form and content of the handbook, and the methods to be used in producing it.

The following decisions were made:

1. The first job is for each member of this committee to send his considered criticism of the proposed outline to the secretary, so that a more or less final form of the outline can be approved soon.

2. The chairman and secretary are to draw up a definition of what is meant by the term "Data Sheet," and include some notes on the preparation of Data Sheets. These notes are to include a list of reputable standard handbooks that may be expected to be available to every engineer. Information contained in these handbooks will not be reproduced in the proposed pulp and paper handbook, except where it is necessary to adapt such information to the pulp and paper industry.

3. Each committee of the Engineering Division will be asked to form a Data Sheets Subcommittee, the chairman of which will be a member of the Data Sheets Committee. Thus the Data Sheets Committee will parallel the function of the function of the Standards Committee in the Testing Division. Each Data Sheets Subcommittee will be assigned jurisdiction over certain specific Data Sheets, and will be responsible for revising and correcting them, as well as for producing new sheets in its own field.

4. The scope of the handbook will be broad, but an attempt will be made first to fill in the gaps where data specific to the pulp and paper industry are needed.

The present draft is an outline for a design and maintenance handbook and was drawn up with the data that a companion operating handbook would be produced later. There was some feeling that this separation will not prove feasible. It is expected that its feasibility or otherwise will be demonstrated as the outline is brought into a more final form, with titles of proposed Data Sheets included, so no decision was taken in this matter.

Mr. Bowle-Evans, chairman of the Canadian Committee, expressed the happiness of his group to attend this meeting. Mr. Hemphill thanked Mr. Bowle-Evans and the other members of his committee for their assistance. It was suggested that the two groups should keep one another posted on their activities, since both groups are working toward the same goal.

The meeting was adjourned at 5:00 p.m.

J. WINCHESTER, *Secretary*

Materials Handling Committee

The business luncheon of the Materials Handling Committee was held on Monday, October 26, at the Sheraton-Mount Royal Hotel, Montreal, Que., with Chairman A. P. Schnyder of Ebasco Services, Inc. calling the meeting to order.

In addition, the following men were present:

John R. Fielding, Union Bag & Paper Corp., Savannah, Ga.
C. E. (Dan) Patch, Morton C. Tuttle Co., Boston, Mass.
A. E. Drew, Southland Paper Mills, Inc., Lufkin, Tex.
Don Luebke, Marathon Corp., Menasha, Wis.
H. F. McLeroy, Union Bag & Paper Corp., Savannah, Ga.
R. F. Coltart, Link-Belt Co., Philadelphia, Pa.

Materials Handling Committee Luncheon

R. C. Max, Factory Insurance Association

E. C. Kurten, Hartford Steam Boiler Inspection & Insurance Co.

Sterling Skinner, Beloit Iron Works

R. C. Berger, General Electric Co.

J. C. Bullock, Link-Belt Co., Albany, N. Y.
W. R. McNally, Link-Belt Co., Chicago, Ill.
R. C. Morehouse, Crown Zellerbach Corp., Port Angeles, Wash.
W. C. Bloomquist, General Electric Co., Schenectady, N. Y.
H. F. Kusz, Link-Belt Co., Chicago, Ill.
Ed. Bing, Link-Belt Co., Chicago, Ill.
H. A. Stoess, Jr., Fuller Co., Catasauqua, Pa.

Mr. Schnyder announced that he was retiring as chairman of this committee, and, expressed his sincere appreciation to all of the members of the committee for their cooperation and assistance. He then turned the meeting over to W. R. McNally, new chairman.

Several suggestions were made regarding topics for the next Engineering Conference and it was decided to make final recommendations to the Engineering Division at the Annual Meeting in New York in February.

Mr. Luebke suggested a paper by someone from the Exide Battery Co. in Chicago, regarding electric trucks and the industry, together with the application of various attachments to these trucks.

Mr. McLeroy suggested a paper on "Preparation of Rolls for Shipment."

Mr. McNally suggested a paper on "Underwater Storage of Wood" together with handling of this wood at the Bowaters new mill in Tennessee.

A. E. Drew suggested that further study of the handling of the different chemicals and materials be made, which would be a follow-up of the paper presented by H. A. Stoess, Jr., at the Tuesday morning session of the conference.

A general discussion was had further regarding bark storage and disposition, and, it was further thought that possibly a round-table discussion on bark handling may be a good topic for next year.

At the technical session of the committee on Tuesday, October 27, H. A. Stoess, Jr., Fuller Co., presented the paper on "Economics of Various Methods of Handling Mill Supply Chemicals" and John Fielding, Union Bag & Paper Corp., described the pulpwood flume system installed at his company's mill in Savannah, Ga.

H. A. Stoess, *Secretary*

Mill Maintenance and Materials Committee

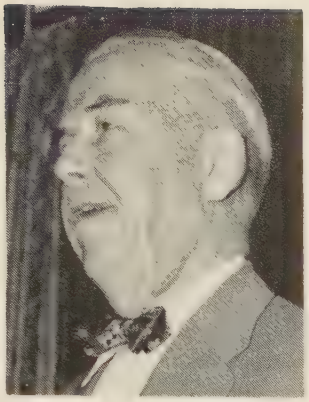
After the luncheon at the Sheraton-Mount Royal Hotel, Montreal, Que., at 1:15 p.m. on Monday, Oct. 26, 1953, the chairman called the meeting to order to discuss the various items of business of interest to the committee. He advised the committee that 16 of the members had replied to the questionnaire which had been sent them prior to the meeting and that they had elected the following topics as the papers to be read at the mill maintenance and materials portion of the 1954 conference: "How Should Maintenance Handle the Spare Parts Problem" and "Evaluating Effectiveness of Mill Maintenance," and that the topic chosen for the round-table discussion was "How Should Maintenance of Meters and Instruments Be Handled." He also advised the committee that the new topics for papers and discussions which had been received on the returned questionnaires would be added to the list of topics for future use and would be submitted when the questionnaire was sent out prior to the 1954 meeting.

The chairman reported that the work on Project 342, "Application Guide on Basic Specifications for Copper and Copper Alloys, Monel and Stainless Steel," apparently is in the same position that it was a year ago and that because of changing personnel on the committee and at the International Nickel Co. that contact had been lost with the work being done on this project but that Millard Hunter of the International Nickel Co. had indicated that he would follow up this project as soon as he received information from the chairman's files relative to its present status.

The chairman reported for Henry W. Downs, Jr., stating that Mr. Downs had prepared questionnaires which he proposed to submit to the pulp and paper mills in order to obtain the information needed to further the work of Project 376, "Screening Capacities of Different Types and Designs of Screen Plates on Various Types of Stock," and read to the committee the following portion of a letter he had received from Mr. Downs: The work on the capacities of slotted screen plates "is continually more involved; I have to gradually accumulate the necessary data. It may take 3 to 5 years before I have presentable data; screen plate capacities depend on type of pulp, consistency, make of screen, or type of screen, type of showers, dilution wells, screen room arrange-

Mill Maintenance and Materials Committee luncheon

. M. Kraus, Stadler, Hurter & Co.



R. A. Packard, Mutual Security Agency

Jacob Gottlieb, Westinghouse Electric Corp.

W. M. Wyburn, Federal Paper Board Co.

ıent of screens, etc. I think the whole thing as far as 'APPI is concerned should be deferred until I can accumulate ıe figures."

Richard H. Smith of Beloit Iron Works presented each of ıose present with a copy of his paper prepared under Project 78, "Compilation of a Check List for Mechanical Preventive laintenance in Pulp and Paper Mills." Mr. Smith's report quite extensive and very complete. It is hoped that most the information submitted can be presented in the form Data Sheets in the near future. The chairman comıended Mr. Smith for the excellent job that he has done in ·tting this information together.

A. M. Cooper, committee secretary, advised that the report ıbmitted last year under Project 379, "Compilation of a heck List for Electrical Preventive Maintenance in Pulp and aper Mills," had not been criticized by any of the committee embers and it was therefore felt that the report on Mainteıance of Motors was in final form and could be presented to ıe Data Sheets Committee for their action and suggested ıat the subcommittee proceed along similar lines covering ontrol apparatus. He was requested to do so.

The chairman reported that the work on Project 380, "A abulation of Protective Coatings for Use Against Corrosive onditions in Pulp and Paper Mills," had not been cometed and that the work was so large that it was felt that out·le help might be necessary to bring this project, on which a rge amount of work has already been done, to completion.

The chairman announced the resignation of B. L. Merriss of ıe Oxford-Miami Paper Co. as chairman of a subcommittee ındling Project 421 on "Maintenance Costs" and explained .at this particular work had been discussed many times over le last several years but that no greater strides had been ıade in accomplishing anything and stated that if anyone resent was interested in the work he would appreciate knowig it so that actual progress could be made under this proj·t.

The committee felt that Project 456, "Substitutes for ritical Materials," should be abandoned as the need for such ıformation was no longer necessary.

The chairman reported that three items had been suggested new projects. It was felt that two of these items could be nsidered by the Subcommittee on Maintenance Training ograms.

A. I. Sippola of the Socony-Vacuum Oil Co. reported for the bcommittee on Lubrication and stated that he had been le to discuss with Henry Muller, acting chairman of the dustrial Relations Committee of the American Society of ıbrication Engineers, the work which that society had in ınd when they contacted the Engineering Division some ars ago. After considerable discussion it was felt that Mr. ppola, acting for the subcommittee, should investigate further what cooperative effort could be made with the American Society of Lubrication Engineers and act as he thought best.

Richard H. Smith of the Beloit Iron Works in reporting for the Subcommittee on Maintenance Training Programs advised that this work would be picked up and carried forward.

The chairman thanked the various members making the reports and expressed his appreciation for the work that has been accomplished by so many.

H. F. PARKER, *Chairman*

Mill Planning and Economics Committee

This gathering was a luncheon meeting called at 12:30 p.m., Tuesday, Oct. 27, 1953. After a satisfying meal the group was called to order by the chairman.

Previous to this meeting a "meeting by mail" had been conducted covering many subjects up for consideration which prepared the several members on topics which would be brought up particularly the change of the wording of the name of the committee, the forming of two subcommittees, and finalizing of the plans for the committee's program to be presented at the October, 1954, conference to take place in Philadelphia.

Members present:

A. E. Ball, Hull, Que.
M. C. Celli, McKeesport, Pa.
S. H. Grimnes, Plattsburg, N. Y.
R. A. Packard, Washington, D. C.
R. G. Seip, Pensacola, Fla.

Members absent:

P. A. Forni, Cohoes, N. Y.

Visitors present:

R. C. Max, Milwaukee, Wis.
F. J. Kraus, Montreal, Que.
Allan Hyer, Watertown, N. Y.
Milton Jacobs, Boston, Mass.
R. G. Macdonald, TAPPI, New York City

Item 1, Name of Committee: After some discussion it was unanimously voted that the name should be changed from Mill Design and Economic Aspects Committee to: Mill Planning and Economics Committee.

Item 2, Organization of Two Subcommittees: It is apparent that the name of the committee covers two divisions of thought more or less separated. Therefore it was recommended and unanimously voted to have these groups labeled as follows with indicated chairmen:

A. Subcommittee: Mill Location, Design and Construction, chairman, Mario C. Celli. This committee will cover

Mill Planning and Economics Committee luncheon

economic considerations relative to mill location, construction and arrangement, nearness to markets for finished products, raw materials, chemicals, wrappings, etc., labor supply (skilled and unskilled), transportation (railway and highway), building requirements (single versus multi-story), width of bays of machine rooms, elimination of columns, soil conditions for foundations, etc. (steer clear of piling and and earthquake areas), power supply, own electric and steam supply versus public utility, proximity to coal mines or oil if needed, water supply relative to quantity and quality. How permanent should mill construction be for chemical pulp mills when consideration is given to rapid obsolescence of equipment which is taking place in order that mills keep within the competitive field? Insulating materials in order that roofs over paper machines may not sweat is worthy of consideration? Living conditions, housing, food supply, sanitation? Must houses be built; investigation of fire and police protection, civic advantages, stores, schools, churches, parks, amusements, etc.? Climate with special attention to humidity and prevailing wind direction, taxation, insurance, and analysis of cost on proposed product are other items to be covered.

B. Subcommittee: Processes, Utilities, and Mill Operation, chairman, Sverre H. Grimnes. This committee will cover economic considerations relative to the arrangement of the various components into an efficient layout taking into consideration the requirements of the productive equipment; appraisal of operation, analyses of causes of shutdowns on basis of preventive maintenance; efficiency of operation not only of machines themselves, but relative to each other (one piece of equipment wrongly installed may affect the operating efficiency of other machines); also consideration of necessary services bearing in mind the limitations of human nature. One of the most important elements in the efficient operation of a pulp and paper mill is the handling of materials. All of these items should work toward a climax of lowering of unit costs of production.

Note for both subcommittees: There will be areas where the functions of these two subcommittees will overlap, but there should be no conflict but rather a supplement to each other. These two subcommittee chairmen may care to submit requested authors' outlines of paper to the other subcommittee chairman as well as our committee chairman for constructive comments which when forwarded to the author, I am sure, will be received in the spirit in which they will be sent.

Will each subcommittee chairman appoint one or more members of the main committee to be on each of their subcommittees.

Item 3, Presentation of the 1953 program: This took place at 11:00 a.m., Wednesday, October 28. A good crowd listened with interest to: "Fire Protection in Pulp and Paper Mills," by R. C. Max, Resident Engineer, Factory Insurance Association, and "Industrial Plant Building in Canada," by F. M. Kraus of Stadler Hurter Co. of Montreal.

Discussions of the two papers took place at 3:45 p.m. the same day.

Item 4, Data Sheet Committee: This committee had a meeting which your chairman attended on invitation. A printed outline of suggested breakdown of tasks ahead with descriptive subheads was distributed to all those present. Up to the time of this committee meeting, the organization consisted of the chairmen of all TAPPI committees; however, it was decided and recommended that a subcommittee be formed under each Engineering Division committee to tackle a much-needed job of reorganization of the data sheets and standards into a more usable mass of important and helpful information. This means that there is a great deal of work ahead. Therefore I am recommending the formation of a subcommittee seeking some member of Mill Planning and Economics Committee to be a subcommittee chairman of our committee—someone who will be interested in going ahead with this type of work. I would be willing to serve on that committee but not as chairman. Please indicate with answer on accompanying sheet.

Item 5, Program for 1954: Discussion took place on many subjects and names of men for authors. After considerable discussion the committee agreed on the following:

For Subcommittee A: "Paper Mill Rehabilitation Involving Rebuilding Old Machine versus a New Machine."

Comments: Mike Jacobs came up with the idea of using Chas T. Main jobs, Mosinee Paper Co. and Finch Pruyn jobs (with or without use of companies' names) as "guinea pigs" for this paper. Harold Ingraham, who is fully informed on these jobs, has been suggested as the author. Will Mario Celli handle this matter by corresponding with Mike, or in any other way he wishes to handle the matter and advise me of the outcome?

For Subcommittee B: "Methods of Preparing and Presenting Requests for Project Approval." This is a much-needed subject because it was the consensus that there is absolutely no uniformity in the manner in which this work is done. Again I suggest that the subchairman appoint one or two members of the main committee to work with him—correspond—select an author and advise the undersigned of his decisions.

It is interesting to note here that the meeting held Wednesday evening of committee chairmen reported comparatively little progress in the formation of a 1954 program. I would estimate that our committee is out front in this work as compared to the others. Let's keep it that way in all we do both in timing and quality.

Item 7, New Members: Upon motions made and duly seconded, unanimously elected were:

A. F. M. Kraus of Stadler Hurter Co. of Montreal
B. Alan Hyer, vice-president in charge of sales, Bagley & Sewall Co., Watertown, N. Y.
C. Milton Jacobs, paper mill engineer, Chas. T. Main Co.

ROLAND A. PACKARD, *Chairman*

Chemical Engineering Committee

Minutes of TAPPI Chemical Engineering Committee meeting, Monday, Oct. 26, 1953, Sheraton-Mount Royal Hotel, Montreal, Que., are as follows:

Members present were:

J. R. Lientz, Chairman
H. O. Teeple, Secretary
Lyle C. Jenness
N. Shoumatoff

I. O. Teeple, International Nickel Co.

Nicholas Shoumatoff, West Virginia Pulp & Paper Co.

Members present of the Chemical Engineering Subcommittee on Digester Corrosion were:

N. Shoumatoff, Chairman	E. W. Hopper
H. O. Teeple, Secretary	F. E. Hutton
S. J. Baisch	E. W. Kieth
P. K. Bloch	J. R. Lientz
H. M. Canavan	W. B. Parker
C. B. Christiansen	H. F. Peters
R. A. Davis	C. W. Smith

B. Thomas

Guests present were:

A. J. Winchester, TAPPI	J. H. Ross, PPRIC
Douglas Jones, CPPA	R. C. Stamm
B. W. Burgess, PPRIC	M. B. Newell

J. Sylvester

The luncheon meeting was opened by J. R. Lientz who ated he was pleased with the number of committee members resent and wished to thank them again for their continued terest in the work being done by the committee.

Mr. Lientz reported that the February, 1954, session of the hemical Engineering Committee would be held in conjunction with the Pulp Purification Committee, R. L. McEwen, hairman. For his part of the February program three papers have been scheduled:

1. "Correlation of Evaporation and Brown Stock Washing," by R. E. Bergstrom and W. G. Dedert.
2. "Corrosion Study in Chlorine Dioxide Bleaching," by H. O. Teeple.
3. "Description of Pulp Washing Equipment at Thilmany Pulp & Paper Co." (tentative), by T. T. Collins and Paul West.

Mr. Lientz reported that a meeting had been arranged between the TAPPI and the CPPA Chemical Engineering Committees for an exchange of ideas and comments. C. H. Rimmer of Howard Smith Paper Mills, Cornwall, Ont., is chairman of the Canadian Committee.

Mr. Lientz remarked that most of the activity in the Chemical Engineering Committee was that of the Subcommittee on Digester Corrosion, N. Shoumatoff, chairman. The meeting was, therefore, turned over to Mr. Shoumatoff.

Mr. Shoumatoff announced that the program for the February session of the Subcommittee had been completed as follows:

1. "Comparative Analysis of Digester Corrosion Measurements, Summary Report No. 2," by N. Shoumatoff and H. O. Teeple.
2. "The History of Carbon Brick Linings in Alkaline Pulp Digesters," by Beaumont Thomas.
3. "A Laboratory Approach to the Study of Digester Corrosion," by John W. Hasler.
4. "Experiments with Digester Corrosion Variables," by E. W. Hopper and J. B. Morrison.
5. "Summary Report—Alkaline Pulp Mill Corrosion Survey," by C. B. Christiansen.
6. "Bibliography on Alkaline Digester Corrosion," by R. P. Whitney and S. J. Baisch (by title).

With respect to the recent study of digester data by Armour Research Foundation under TAPPI Research Grant No. 50, Mr. Shoumatoff stated he was well pleased with the results. However, it should be noted that all the work outlined initially had not been completed because of a lack of time. Armour had performed the reduction of the raw data which, with some additional computational work, would result in the committee's being able to present more useful information to the industry.

The results of the study to date were quite informative and provided the basis for the committee paper presented at this Engineering Conference.

Additional correlation of the results of the Armour study to date will provide the basis for the committee paper to be presented in February. This paper will largely deal with other effects than corrosion rates of various materials of construction which constituted the bulk of the present paper.

Mr. Shoumatoff said the work next year for the committee would be to establish a mechanism for the continuous collection and evaluation of inspection data as accumulated by the mills. These data would pertain not only to those digesters already studied but also to those digesters not previously studied by Armour.

Further, better answers are desired to these questions:

1. How to reduce corrosion of existing digesters.

2. How to specify digester materials of construction for optimum economical corrosion performance.

3. What is the trend of digester corrosion in relation to probable future developments: (a) high yield; (b) hardwoods; (c) NSSC make-up; (d) continuous pulping; (e) prehydrolysis.

Mr. Shoumatoff reported that the work on the forthcoming TAPPI Monograph No. 12 on Digester Inspection was progressing nicely. All chapters have been submitted and Jack Winchester of the TAPPI staff had taken on the job of editing the monograph. It is anticipated the monograph will be distributed prior to the February meeting. It is believed this monograph will fulfill the needs of the individual mills for an inspection procedure. It should stimulate the collection of continuously improving reliable data of wider scope for further study.

Claud Christiansen of PPRIC made a few remarks on the status of the Canadian study.

The meeting was adjourned at 5:00 p.m.

H. O. Teeple, *Secretary*

Chemical Engineering Committee luncheon

Steam and Power Committee

Following are the minutes of the meeting held during the 8th Engineering Conference, Sheraton-Mount Royal Hotel, Montreal, Que., on Tuesday, Oct. 27, 1953. Those present were:

Members:

W. M. Wyburn, Chairman
J. Gottlieb, Secretary
H. R. Emery
D. C. Edmiston
W. H. Hall
R. V. Knapp
N. H. Mailhos
R. G. Macdonald
M. F. Schanufer
R. H. Sogard
J. E. A. Warner
W. M. Wyburn
V. P. Owens
H. B. Wallace
W. B. Wilson

Guests:

P. L. Nelson, Chas. T. Main Co.
W. C. Bloomquist, General Electric Co.
F. D. Snyder, Westinghouse Electric Corp.

Mr. Wyburn opened the meeting and there was a general discussion of a number of topics that had been presented as subjects for the 1954 meeting. The members were requested to vote on a final choice of subjects and the results tabulated below are the topics which will be used.

Main Program:

1. "Maintenance Procedures for Preventive or Scheduled Outage of Power Plant Equipment."
2. "Survey of Bark Dewatering, Storing, and Handling."

Round Table:

1. Outdoor power plants with comments on design for Northern climates, and a discussion of practices and design for reducing costs of power plants designed for paper mills.

Appoint of Subcommittees Long-Range Projects:

1. Training of Power Plant Engineers: J. E. Warner, chairman; V. P. Owens, assistant.
2. Yearly Compilation of Data of New Paper Mill Power Plants: R. H. Sogard, chairman.
3. Data Sheets: W. H. Hall, chairman; W. B. Wilson and V. P. Owens, assistants.

J. Gottlieb, *Secretary*

Steam and Power Committee luncheon

Hydraulics Committee

The Hydraulics Committee presented one paper at the 8th Engineering Conference in Montreal on Monday, Oct. 26, 1953. This paper was entitled "A Progress Report on Pipe Friction Studies" and was presented by Mr. Durst of the University of Maine, Orono, Me.

Hydraulics Committee luncheon

This paper was a report of the work being done on pipe friction loss at the University of Maine, under a TAPPI research grant, during the last year. This report indicated that much progress had been made and that correlation had been obtained between a laboratory shear tester and a pipe system for bleached sulphite pulp at varying consistencies and velocities. The paper was well received and favorably commented on.

A discussion meeting was held on this paper the same afternoon, attended by approximately 25 people. Professor Jenness and Mr. Durst presented to the meeting a number of difficulties they were having with their test setup and received many valuable suggestions from those present. A very spirited discussion took place for about an hour and a half.

The Hydraulics Committee held a luncheon and business meeting on Oct. 27, 1953, attended by ten members, at which the following items were discussed and the indicated action taken:

1. It was decided that reruns should be made on the present shear tester and piping system, using two pulps of different characteristics than bleached sulphite at two consistencies and two velocities to see whether or not the same correlation held. The pulps selected were hardwood sulphite and unbleached southern kraft.
2. Certain defects in the design of the present shear tester were discussed and new designs were suggested. Various members of the committee agreed to have the necessary parts for a new design of shear tester made in their respective plants from drawings supplied by the University of Maine, in order to hold down the expense of this project.
3. At the 7th Engineering Conference it was suggested that the Hydraulics Institute be approached with the suggestion that they help finance this project. V. deP. Gerbereux reported that the Executive Committee of the Hydraulics Institute had turned down the request on the grounds that it would set a precedent for the support of research in other industries.
4. Mr. Mackenzie gave a report of the financial status of the project, showing that all of the TAPPI funds granted to date had been expended and the University of Maine had spent an additional $1004.37 to complete the work necessary for the presentation of the present progress report.
5. Professor Jenness and Mr. Durst estimated that 2 years' additional work will be required to complete this project at a cost of $5000 per year. It was decided to ask the Research Appropriations Committee to grant an additional $11,000 for this project, $1000 to reimburse the University of Maine for work done to date and $10,000 to be spent over the next 2 years.

K. J. Mackenzie, *Chairman*

apermaking (Cylinder) Committee

At a committee meeting held at TAPPI headquarters in ew York on Nov. 6, 1953, final plans were made for the ogram to be presented at the 1954 Annual Meeting, Feb. –18, 1954, in New York.

The theme of the February sessions is to be "Smoothness of perboard Including Both Visual and Printing Smoothness." is subject will be dealt with under the following eight adings: General Scope, End-Use Requirements, Testing, ishing, Drying, Wet End, Stock Preparation, and Raw aterials. A paper will be presented under each of these adings, in which the factors in each of the above areas will discussed as they influence the various undesirable qualities ecting the smoothness of the sheet, viz.: lumpy formation, t marks, wire marks, foreign matter (shiners, slime spots, .) fuzziness, interfiber voids, incompressibility, surface ds, check, crush, cockles, and mechanical damage (in- ding scabs, press cuts, and calender cuts).

These eight papers will constitute the program on Tuesday, bruary 16. On Wednesday morning, February 17, G. T. negar will review the papers briefly, following which an n discussion of the entire subject will be held.

Lists of factors involved in smoothness under each of these dings are given below, along with the names of the chair- n responsible for the various sections of the meeting, and names of the speakers which have been announced to date.

oothness of Paperboard Including Both Visual and Printing Smoothness

General Scope: Chairman and Speaker—Glen T. Renegar, Container Corp. of America, Philadelphia, Pa.

End Use Requirements: Chairman—T. Luey, Sutherland Paper Co., Kalamazoo, Mich.; Speaker—T. Luey.

A. Boxboard used in the manufacture of cartons should appear smooth to the naked eye. Defects in this class are:
   1. Cockles.
   2. Checks.
   3. Crush.
   4. Scab marks.
   5. Lumps due to foreign matter.
   6. Felt marks.
   7. Wire marks.
   8. Mechanical damage, such as press and calender cuts.

   The above defects are normally quite obvious and will cause substantial troubles in printing. They are determined visually.

B. Boxboard used for printing should have sufficient smoothness to permit the proper reproduction of the design. The smoothness requirements are dependent on the type of printing process involved: i.e., offset, gravure, or letterpress. The letterpress process has the highest requirements for smoothness and factors of concern here are of less importance in the offset and gravure methods.

   Smoothness deficiencies of this class can be divided into two types:

   (a) Small surface irregularities.
      1. Interfiber voids.
      2. Fuzz.
      3. Fine felt and wire marks.

   (b) Formation irregularities.
      1. Lumpy or wild formation.
      2. Streaks due to weight and caliper variations across the sheet.

C. A secondary factor affecting smoothness during printing is the compressibility of the board. The easier it is to compress a board the more readily will it lose its surface roughness during printing. Factors affecting this characteristic are:
   1. Softness of fibers.
   2. Density of the sheet.
   3. Moisture content.

3. *Testing:* Chairman and Speaker—T. Luey.
   A. Instruments and methods of measuring smoothness of a free surface.
      1. "Use of Grazing Light to Produce Areas of Light and Shadow," Instrumentation Studies VIII; *Paper Trade J.* 104, No. 11 (*TS*157–160).
      2. "Use of Microscope and Measuring Focusing Adjustments on High and Low Spots in Sheet," Instrumentation Studies VIII.
      3. "Electrical Capacitance Method," Instrumentation Studies X.
      4. "Use of Stylus to Follow Surface Contours," *Tech. Assoc. Papers* 25: 619 (1942).

   B. Instruments and methods of measuring smoothness of a surface under pressure.
      1. "Bekk and Gurley Instruments," Instrumentation Studies IX; *Paper Trade J.* 104, No. 12: 62–66 (*TS* 174–178).
      2. "Williams Smoothness Tester," Instrumentation Studies XXV; *Paper Trade J.* 106, No. 4 (*TS* 34–38).
      3. "Gurley Hill SPS Tester," Instrumentation Studies XXXVI; *Paper Trade J.* 110, No. 23 (*TS* 302–309).
      4. "The Chapman Method," *Pulp & Paper Mag. Can.* 48, No. 3: 140–150.

   C. Evaluation of printing smoothness by printing.
      1. Berberich and others, *Tech. Assoc. Papers* 31: 281–286 (1948).
      2. Diehm, R., *Tappi* 33, No. 2: 42A–48A (1950).
      3. Eckhart and Burnett, *Tappi* 36, No. 8: 369–371 (1953).

4. *Finishing:* Chairman—P. Smith, Continental Paper Co., Ridgefield Park, N. J.; Speaker—K. M. Winrich, Cornell Paperboard Products Co., Cornell, Wis.
   A. The following factors are involved in the degree of "supercalendering" or "smoothing" when a dried or semidried sheet is reduced in bulk by a calendering operation (in other words, reduction in bulk or increase in density can be accomplished in many different ways, but the following factors are vital in how much smoothing is accomplished when bulk is reduced):
      1. Roll diameters.
      2. Types of rolls.
      3. Number of stacks and number of rolls per stack.
      4. Solutions used and places of application.
      5. Nip pressures.

   B. Other items also known to be very critical:
      1. Moisture content at the calender.
      2. Picking of rolls and scabbing.
      3. Calender creases.

5. *Drying:* Chairman—P. Smith; Speaker—K. M. Winrich. The following are the factors in this area that govern the smoothness of the sheet:
   1. Drier surface smoothness and cleanliness (controlled by doctoring).
   2. Rate at which surface temperature is brought up and maximum temperature attained.
   3. Sheet tension throughout the driers.
   4. Slippage in the last section.
   5. Smoothing in drier sections with the use of smoothing rolls.

6. *Wet End Operation:* Chairman—G. C. Ehemann, Jr., Ohio Boxboard Co., Rittman, Ohio.

   "The Design and Operation of a Press Section for

Good Finish," by Baxter Chamberlain, Container Corp. of America, Wabash, Ind.

"The Design and Operation of a Vat Section for Good Finish," by *Duncan Brawn*, The Gardner Board and Carton Co., Lockland, Ohio.

A. Press section check list of factors affecting finish
   1. Lumpy formation—none.
   2. Felt marks.
      A. Type of felts.
         1. Affected by helper drive.
         2. Felt whipper.
         3. Spreader rolls.
         4. Suction box lips.
         5. Other mechanical aspects.
      B. Nip pressures.
         1. Number of nips.
         2. Roll sizes.
         3. Roll design.
         4. Felt line.
         5. Cover plastometers.
         6. Roll overhang.
      C. Subsequent pressing.
         1. Number of finishing presses.
         2. Design of presses.
         3. Type of felts.
         4. Operation.
   3. Cylinder wire marks.
      A. Couch pressure.
      B. Effacement in finishing presses.
      C. Couch cover plastometer.
   4. Extractor wire marks.
      A. Face wire design.
      B. Nip pressures.
      C. Cover plastometers.
      D. Bottom roll design (suction or plain).
   5. Foreign matter—none.
   6. Fuzziness—none—see Surface voids.
   7. Interfiber voids—none.
   8. Incompressibility.
      A. Press section design (suction, etc.).
      B. Nip pressures.
      C. Cover plastometers.
      D. Speed.
   9. Surface voids—felt pick.
      A. Number of presses.
      B. Felt line.
      C. Roll overhang.
      D. Slices.
      E. Nip pressures.
      F. Nip water removal.
      G. Type and condition of felts.
      H. Cover plastometers.
   10. Check.
      A. Type and condition of felts.
      B. Design and arrangement of presses.
      C. Roll overhang.
      D. Nip pressures.
   11. Crush.
      A. Type and condition of felts.
      B. Design and arrangement of presses.
      C. Roll overhang.
      D. Nip pressures.
   12. Cockles—none.
   13. Mechanical damage.
      A. Press cuts.
         1. Press section design.
         2. Draw control.
         3. Mechanical condition of press equipment.
         4. Felt wrinkles.
      B. Scabs.
         1. Doctors.
      C. Felt damage.
      D. Dirt on felt.

B. Vat Section check list of factors affecting finish.
   1. Lumpy formation.
      A. Cylinder overload.
         1. High consistency.
         2. Retarded drainage.
         3. Speed.
         4. Inadequate forming areas.
      B. Flocculation.
         1. Entrained air.
         2. Low velocities.
         3. Temperature.
         4. Fiber characteristics.
         5. Chemicals.
      C. Cylinder fill-up.
      D. Vat and cylinder design.
      E. Vat operation (control by operator).
   2. Felt marks—none.
   3. Cylinder wire mark.
      A. Face wire design.
      B. Vat type.
      C. Vat operation (consistency, volumes, head etc.).
   4. Foreign matter.
      A. Vat system design for clean-up.
      B. Proper clean-up.
      C. Slime control treatments.
   5. Fuzziness.
      A. Vat operation (mold head, consistencies etc.).
   6. Interfiber voids.
      A. Face wire design (retention of fines).
      B. Vat operation.
   7. Incompressibility.
      A. Vat operation (mold head, vat load, etc.).
   8. Surface voids—felt pick—none.
   9. Check.
      A. Vat operation (later removal).
   10. Crush.
      A. Vat operation (water removal).
   11. Cockles.
      A. Vat operation (see Lumpy formation).
      B. Vat type (counterflow or direct flow).
   12. Mechanical damage.
      A. Face wire condition.
      B. Deckles.
      C. Rain.
      D. Dirt on mold.

7. *Stock preparation:* Chairman—E. Manogue, Gibralt Corrugated Paper Co., North Bergen, N. J.; Speaker O. P. Fussell, Lowe Paper Co., Ridgefield, N. J.

   The following factors may affect the smoothness of t finished board.
   1. Type of furnish.
   2. Cleanliness.
   3. Development of fibers through hydration an cutting.
   4. Overdeveloped stock causing cockles, checks, an picks.
   5. Loading; size, clay, starch, alum.
   6. Freeness.
   7. Consistency regulation.
   8. Quality of supply water.
   9. Air content of stock.
   10. Agitation.
   11. Additives to retain pigment.

8. *Raw materials:* Chairman—A. E. Bachmann, Missisqu Corp., Sheldon Springs, Vt.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

ew England

The December meeting of the New England Section was afternoon and evening affair featuring a visit to the Chemi- l Paper Mfg. Co., Holyoke, Mass., and a technical program the afternoon with a dinner followed by the presentation a movie "Deep Water" through the courtesy of Layne- ew York, Inc.

The technical program consisted of two papers: "Analysis Variance in Dealing with Mill Data," by Geoffrey Beall, ofessor of Statistics, University of Connecticut, Storrs, nn., and "Waste Disposal Problems of the Small Mill," Harry Gehm, Technical Adviser, National Council for eam Improvement, New York, N. Y. The texts of these pers follow this report.

The New England Section of TAPPI has voted to offer free mbership in the Section to all upperclass students in the per Engineering Dept. of Lowell Technological Institute, well, Mass.

The names of the men awarded membership are:

NIORS:
Glasheen, Edward Arthur
Hallas, Kenneth Barnes
Higgins, Charles James
Marchand, Albert Joseph
Pelliccione, Robert Joseph
Rushton, Warren Stanley
Sargent, Thomas Joseph
Tournas, Arthur
Walechowski, Edwin

JUNIORS:
Hince, Lawrence
Iannazzi, Fred Domenic
Kane, Edward Hugh
Karp, Herbert Eugene
Lind, Clark Herbert
Nagle, Robert Thomas
Powell, Henry Joseph

At the December 4 meeting of the Section at the Roger ith Hotel, Holyoke, Mass., a representative group of these n were present, and they were formally introduced by fessor John Lewis, Head of the Department of Paper gineering.

The present enrollment, in addition to the above upper- smen, is 13 sophomores. About 25 freshmen are expected nroll in the Spring semester after a common Fall semester all freshmen.

R. W. RAMSDELL, *Secretary*

Analysis of Variance in Dealing with Mill Data

Geoffrey Beall

MY POSITION is difficult because many of you under- d the general question of analysis of variance and will nothing new. Those who are unfamiliar with the pro- ure may be so concerned with some one of your immediate blems that you may not realize that I am only dealing a small part of statistical theory—possibly inappli- e—and be disappointed. Under these handicaps I will to indicate the general nature of analysis of variance and broad class of mill problems to which it applies.

o indicate the general nature of the problem I shall first t out its similarity to process control charts (with estab- d limits on statistical grounds and not arbitrarily by management). I can presume that most of you have some familiarity with the control chart where the important feature is that we say points outside certain limits are to be taken as an indication of lack of control. Variation between the limits is to be tolerated and is not to be the occasion of adjusting the process. While there exists a possibility of this system misleading us slightly it will give less such confusion than any other system of decision. The operation has been recently likened to that of transmitting a message by wireless. Then we receive a mixture of message and static and have to make up our minds which is which. We shall seldom go wrong if we suppose the variation in product that lies between the limits is the static or our operation while the occurrence of a point outside the limits is a message from the process that all is not well; it is a call from the process for attention. Analysis of variance is concerned with the same problem of distinguishing genuine parts of a message due to the process from the static included in our operation.

Analysis of variance differs from process control in that it involves a more reflective contemplation of the process. Perhaps product has been made for many months but it is advisable to consider whether there is an indication that the process leaves something to be desired or to be corrected. In contrast process control involves a decision from moment to moment as to how the process is behaving and whether any remedial steps should be taken. Analysis of variance is the careful study of a document whereas process control is a conversation.

Let me present one very simple illustration of a body of data amenable to analysis of variance as below. It concerns moisture determination at three positions across a machine for four reels. We have:

Reel	*Position* 1	2	3	*Reel average*
1	2.3	2.3	3.6	2.7
2	3.7	3.8	4.3	3.9
3	3.4	4.6	3.6	3.9
4	2.7	4.2	2.8	3.2
Position average	3.0	3.7	3.6	3.4

We have struck averages for reels and positions—as would anyone—with the idea that these will tell us whether any of the reels or positions were unusually high or unusually low. Now, however, we come to the statistics when we consider that any given result, say the third position across the second reel (moisture 4.3) may be subject to a good deal of static. By this we mean that it is 0.9 above the general average of 3.4 not only because it belongs to a reel that may be high and not only because it comes from a position that may be high but because the record gives a little high squeal at this point. We can never say how much this is part of the actual production and how much is due to the testing room—both must contribute to the actual static of the operation. We must be prepared for some such chance and incoherent element in the observation of 4.3 that will play a part in the average for the second reel. Similar chance elements, error or static, may conceivably enter into each of the twelve observations of the table and enter into the averages for, let us say, the reels.

FREY BEALL. Professor of Statistics, University of Connecticut, Storrs.

New England Section December meeting group

Finally we come to the question of whether the variation among the averages for reels consists of anything but this error or static. If the variation in reel averages consists of nothing else we should not concern ourselves with the variation among them as something genuinely characteristic of the reels but only as a problem of chance fluctuation or static.

The present is not the time to go into the details of how one decides on whether the variation among the reel averages has an indication of true variation among the reels. The details of analysis of variance can be found in many books by anyone who has become interested in the idea.

At the moment it is probably more important to point out that many situations in the mill may be surveyed in this way. We might, for instance, consider some character of pulp cross-classified according to source and time in order to discover whether there was any clear over-all difference according to source or time. The only important character of the data is that we have an observation to put in each position for source and for time—as in the small present illustrative table.

Another use of analysis of variance is to give each of several testers a part of each of several materials. We should then get results like the above by three testers on each of four lots of pulp. We might explore for the inconsistency or static in their determinations and in contrast look for any systematic tendency for the testers to be high or low.

We might again run an experiment where four starches were tried with each of three furnishes. When tests had been made on the resulting product we should again have a table of twelve values that might be studied for consistent differences due to furnish and for consistent differences due to kind of starch. We should judge the significance of such differences by studying whether they might be merely the accumulated inconsistencies of the individual items.

The one technique of analysis of variance may be used for the most various practical situations. The aspect of the analysis that is to be stressed will, however, vary according to circumstances. Thus in the case of the furnish and starch experiment we should not be interested in the experimental error or static except to be sure that we are not making a report on averages for which it is the major element. The experimental error is simply a nuisance. In the case of the survey of testers on various lots of pulp we should certainly not be much interested in whether the lots of pulp differed. We should possibly be little interested in whether a tester was systematically high or low—his comparison of two pulps would be unaffected so long as he equally tended to high results for each. We should be definitely interested in the experimental error or static.

We may conclude with two cautionary remarks. First, a survey of the position versus reel type the analysis variance, while quite proper, does not tell the full story f many practical purposes. Thus we may find that the vari tion due to positions across the machine is significant and t variation due to reels is significant. We may then suppo that we might appreciably better our product by introduci process control in these two directions. In this we may disappointed. The reason may be that while the effects and across the machine direction are consistent and cle they still contribute no great percentage to the total vari bility of the product. Let us not attempt to explore th question fully but remember it as a question that may nee an answer. The second caution is that not all mill exper ments are suitably explored with an arrangement like that the small illustrative table. For instance, it would be foll to explore the concentration of reagent and of cooking tim as necessary for a new wood, in all combinations of the tw Extreme concentration for a long time would almost sure give a poor yield of pulp or poor pulp. The criterion whether an analysis of variance experiment of all combinatio should be run is whether all combinations have any practic interest.

Waste Disposal Problems of Small New England Mills

Harry W. Gehm

In discussing waste disposal problems of the sma mill, the problems to be considered involve the character of th mill discharge, its effects on the stream, and its response existing waste treatment methods. Also, the common chara teristics of small streams in New England must be taken in account since their properties in respect to self purificatio are frequently unique.

Spent process waters from this type of mill can be divide into two general classes. These are: (1) those not contain cooking liquors and (2) those containing cooking liquors.

The first type consists mainly of overflow white wat The major polluting constituents of these is suspended matt although some may contain considerable dissolved organ matter derived from cellulose degeneration, residual coo liquor, organic sizing or adhesives, and debris if old papers a used in the process. Both dissolved and suspended organ matter are oxidizable by microorganisms and can be respons ble for reduction in the dissolved oxygen in receiving water

Suspended matter can be divided into three general classe These are as follows: (1) coarse material removable b screening, (2) settleable solids, and (3) nonsettleable solids.

The first class consists primarily of fibrous matter as can th second, although where fillers are employed the inorgan content can be high. The third class is high in inorgan matter due to filler and coating materials.

The second type of effluent is similar to the first excep that superimposed upon it is a relatively large amount of di solved organic matter resulting from the cooking proces Such effluents may also be high in pH and alkalinity due the use of caustic soda or other alkalies in pulping rags, rop jute, or flax or in deinking old papers. Use of sulphides an sulphites in such pulping processes may alter the nature the waste since such compounds can produce taste and odor i water of themselves or as part of the decomposition proces They have an avidity for dissolved oxygen and are potentiall toxic to aquatic life.

Sources of effluents from pulping processes of this type a generally as follows: (1) blow liquor, (2) beater wash wate and (3) bleach wash water.

Suspended matter can have several effects on a receivi

Harry W. Gehm, Technical Adviser, National Council for Stream Improv ment, New York, N. Y.

tream. It can cause turbidity and discoloration as well as rm sludge deposits. If organic, it is inclined to undergo icrobial decomposition, either in suspension or in deposits nploying dissolved oxygen derived from the water in oxida- on of the organic matter. As aquatic life depends upon dis- lved oxygen for its respiration, too great a depletion of it ill cause fish to die or move elsewhere and the development of sh food organisms is hindered rendering the area unattrac- ve to desirable species of fish life.

Dissolved organic matter decomposes with depletion of xygen and is frequently the cause of discoloration (cooking quors and dyes). If sufficient is discharged in relation to vailable dilution, the entire stream may go anaerobic, turn- g black and producing noxious odors since conditions become ducing rather than oxidizing.

The discharge of alkali is not generally as serious as one ight imagine since it is generally neutralized to a large tent by acidity in both paper machine overflow water and ream water. Also, aquatic life is tolerant to relatively high kaline levels. Damage from this source is almost invariably ue to irregular discharge of "slugs" of highly alkaline wastes ch as blowdown liquors.

Methods for reducing the suspended solids content of ma- ine overflow waters apply the principles of flotation, filtra- n, sedimentation, and sludge blanket clarification. The oice of equipment depends upon many factors, the most portant of which are the product manufactured, raw ma- rials employed, water reuse, removal requirements, and ether or not the recovered solids can be returned to the ocess for incorporation in the product. It is the case with ost machine waters that a high degree of clarification can be nsistently obtained if suitable equipment of adequate capac- is employed, if it is properly installed and integrated in e system and given adequate supervision and maintenance. e major problems arising in clarifying operations have en difficulties due to fluctuations in waste flow, tempera- re, and solids content, as well as the presence of entrained or gases formed by the reaction of coagulants or fillers esent in the effluent. Apparent lack of improvement in rified effluents as based on appearance and caused by nute concentrations of fine titanium pigments has in some stances been troublesome.

Reuse of clarified machine waters where dyes are em- oyed has led in many cases to great improvement in the ap- arance of receiving streams. Clarification will remove m 30 to 60% of the oxygen demand from most machine erflow waters but cannot be expected to remove much of e demand caused by dissolved organic matter. Recircula- n of a portion of the clarified machine water will reduce e average daily dissolved B.O.D. load discharged but as ssolved matter builds up in the system the load discharged the end of a machine run becomes abnormally high.

The earliest attempts to relieve pollution resulting from the scharge of cooking operations were the segregation and rage in lagoons of the blowdown liquors during periods of w stream flow. This technique required the presence of table land adjacent to the mill and sufficiently removed m habitation so that the odor of the stored liquor would t create a nuisance. In some instances where the land was ited the liquor was collected daily and treated batchwise th coagulants such as alum and calcium chloride. After tling, the supernatant was decanted and discharged propor- nally and the sludge lagooned. Disadvantage of this thod of treatment over and above the high chemical cost s the fact that only from 10 to 25% of the oxygen demand s precipitated, although color reduction was high. Sludges produced were voluminous and did not drain or dry readily. tempts to evaporate blow liquor at one rag mill have not, our knowledge, been successful due mainly to foaming. tendant odors also make evaporation a questionable ap- oach irrespective of the relatively high cost of this operation

H. W. Gehm, National Council for Stream Improvement and F. S. Klein, Byron Weston Co.

and the residue disposal problem remaining. More encouraging than attempts to treat the blow liquor alone, has been work on combined mill effluent. Treatment of the combined discharge at one mill in a large oxidation lagoon has resulted in the removal of most of the suspended matter and a substantial portion of the oxygen demand. This mill pulps mainly jute. Trickling filter experiments carried on at a rope mill indicate that the combined waste can be oxidized to an appreciable degree in this device if sufficient ammonia is added and the feed waste maintained substantially neutral in reaction. The limitations of these methods are, in the case of oxidation lagooning, the large area of land required and in the case of the trickling filter, high capital and operating cost. Recent experiments sponsored by the National Council for Stream Improvement have dealt with treatment of the blow liquor combined with the wash water obtained during the first hour of beater washing. This combination yields a large percentage of the total oxygen demand contributed by the pulping operation in a relatively small volume of water. Treatment consists of aerating the waste for periods varying from 12 to 24 hr. with low pressure air after the addition of ammonia and in the presence of a dispersed microbial seed material. B.O.D. reductions approaching 90% have been obtained in the laboratory on some cooker wastes. Foaming troubles have eliminated this technique as a possibility for treating others such as flax pulping effluent. Neutralizing requirements must also be considered in the application of any biological process. Pilot plant tests of this process are now under way at one mill and others are considering such test work.

In many instances in New England mills are located on very small streams which, with impoundment at the mill site, provide little more than sufficient water to operate the plant during periods of low stream runoff. This means that the mill effluent receives but little dilution on discharge. Fortunately most such streams are shallow below the mill site and consist of a series of pools and riffles. The riffles provide means whereby the water is continuously re-aerated providing in a short distance of travel the oxygen necessary for rapid oxidation and prevention of anaerobiasis with its attending nuisance. Also, nature provides a high degree of seeding in such cases in the form of heavy slime growth attached to the rocky bottoms. Under these conditions algae also supply oxygen at a high rate since their respiration is the reverse of the bacterial forms. Under these conditions purification rates increase to from 5 to 10 times those normally observed for streams of cannular cross section. This means that the major effects of the wastes are nullified after a relatively short distance of travel or time of passage. In some instances, a high degree of self purification will occur in a

heavily laden stream as little as 5 miles below the mill, whereas the same degree of purification might require as much as 25 miles of flowage in a deep stream. Hence, a short section of the stream is sacrificed to protect the greater portion.

Alleviation of pollution under these conditions lies in two categories. One is to provide sufficient treatment of mill effluents so that nuisance does not occur and self purification is allowed to proceed rapidly. Little more can be expected of waste treatment under these conditions because of economic considerations, even though improved methods are developed. The second approach is providing more water in receiving streams during the Summer months through added storage and more prudent regulation and usage of existing supplies.

Empire State (Central District)

The December monthly meeting of the Central District, Empire State Section of TAPPI, was held at the University Club, Syracuse, N. Y., on December 4. A social hour preceded and 85 attended.

Harry Gray, chairman, introduced the following members of the head table and members of the Empire State Section Executive Committee which had met that afternoon at the Forestry College: Ralph Prince, D. Chace Mather, Earl Sommerville, Horace A. Spencer, Ralph Kumler, Robert M. Drummond, John Crocker, George Martin, Wm. R. Willets, and James D. Parmele.

F. W. O'Neil introduced Bert Channer, technical representative of H. Waterbury & Sons Co., Oriskany, N. Y., who spoke on "Cylinder Machine Felts for Mills in the Syracuse Area." A copy of his talk is enclosed.

A brief discussion followed and was concerned mainly with practical ways to improve felt life and the use of synthetic fibers in papermaking felts.

S. E. Church, *Secretary*

Cylinder Felts for Mills in the Syracuse Area

Bert L. Channer

As the title of this paper indicates, we are primarily concerned with felts for cylinder machines—both multicylinder and single cylinder.

We will also spend some time on weaves, felt classification, and the use of synthetics in paper machine felts. Some of this paper contains facts with which you are already familiar. Some of the material you may not have read before. A paper of this type is, of necessity, more general than specific—paper machines varying as they do. You may read something in this paper with which you will not agree, but please remember that we are not attempting to discuss felts for a particular machine. A felt which will not work at all on one machine, may work very well on some other machine.

WEAVES

Although there are many different weave patterns being used today by the felt industry, there are five which are most commonly used: the plain weave, the broken twill, the satin weave, the tiger, and the twill.

Before getting into a description of these, it might be well to get a few terms straightened out. In the felt industry the machine direction yarns are known as warp ends. The cross-machine yarns are filling. The individual filling yarns are known as picks. Therefore an 18-pick felt will have 18 cross-machine or filling yarns per inch. The number of warp ends will vary according to the type of felt and the position requirements.

Bert L. Channer, Technical Representative, H. Waterbury & Sons Co., Oriskany, N. Y.

B. L. Channer, H. Waterbury & Sons; H. M. Gray, Oswego Falls Corp.; D. C. Mather, Carthage Paper Makers Inc.; and F. W. O'Neil, College Forestry, State University of New York

The plain weave is the simplest of all. In it, the pick goes over every other end and under every other end. The next pick is exactly opposite. The same weave is used in making burlap, baskets, and a hundred other items. This weave is used in cylinder tissue felts, Yankee bottom felts, pulp machine felts. It has many other applications. It is, of course, a two-sided weave.

The broken twill weave is the next step from the plain weave. It, too, is a two-sided affair. In this weave one pick goes over and under the warp ends two at a time. The next pick is plain weave. This succession is continued on in such a manner that the twill effect is broken. An alteration of this weave makes each pick over two and under two. Finish and drainage are somewhat improved with this weave pattern. It may often be found on fourdrinier presses making newsprint.

The next is the satin weave. This is a group of weaves designed to give better finish and improved drainage. These are all one-sided weaves in which the filling passes over three or more ends and under one. They may be woven as 3 and 1, 4 and 1, or 5 and 1. The 3 and 1 satin weave is of interest in this paper, since most cylinder top and bottom felts are constructed with this weave pattern.

The tiger weave is a two-sided 3 and 1. It makes a bulkier felt with more cushion. Such weaves are used on high-speed fourdrinier presses making kraft.

The twill weave is commonly used in making Yankee pickup felts and in some super plate felts. It is normally used only in high pick work—90 to 100 picks or higher. It makes a felt with a smooth, hard surface and the twill pattern is minimized with the great number of fine picks.

FELT CLASSIFICATION

I think a word about felt classification would not be out of place in this paper, since I have found that while the purchasing department as a rule is pretty well up on this subject often the man in the mill is a little hazy as to what fine press or common wet really means.

In general, there are 10 main classes of felts, so divided as to reflect the cost of manufacture of each class. Within each class, limits are placed on the fineness of the wool which can be used in the felt, the size of the yarns, the number of picks (cross-machine direction yarns) per inch, and the maximum finished weight of the felt, usually expressed in ounces per square foot. A felt which falls within the specified weight limit is sold according to size and priced from a published price list. A felt heavier than the weight limit is termed extra heavy and is sold by its weight, according to a specified price per pound.

MULTICYLINDER MACHINE FELTS

Bottom

If it were possible to pick out one felt on a multicylinder

hachine more important than any other, one would probably elect the bottom felt. This is true since in the conventional ook-up the bottom felt does most of the work. First of all, must pick up a ply of paper stock from each cylinder on the hachine and carry it on its under side to the far end of the hachine where the whole unit is reversed. This may well be 0 ft. and more. Second, the felt must be very strong since acts as a power transmission belt, turning the various olds, couch rolls, extractors, felt rolls, wringers, and primary esses. A third requirement is that the felt be able to absorb ater and allow it to drain through without filling up, since a ugged felt may cause blowing or checking and operation beomes far from satisfactory. Lastly, the surface of the felt ust be smooth enough so as not to excessively mark the eet. When carried to extremes, a bottom felt may mark he sheet so badly that some of the impression may even show rough to the top of the board. We need not even mention vo other requirements—it must fit the machine and it must n satisfactorily for a reasonable length of time.

In considering the requirements outlined above, two oughts become apparent. First, it seems a little amazing at a felt can be made to do all of the above at the same time. nd second, any bottom felt must of necessity be a compro-ise, since when we think of power transmission, we think of rge, strong yarns. But such yarns would leave deep imessions on the sheet. To overcome this we might try ner filling yarns with more picks, but there arises the filling o problem, and as we have said, this felt must remain open. o how can the felt manufacturer construct a felt to meet ese requirements and still have it run a reasonable length of ne?

Well, first of all he selects a weave. It's no secret that toy most bottom felts are woven with a 3 and 1 satin weave. ormerly, these felts were woven with a two-ended plain eave, but as finish became more important, the satin weave as substituted. Next, the felt designer selects the wool and rns which will be used, and here we reach our first compro-se. The wool for the warp must be strong but what about rn size? We know that, using the same wool, the stronger e yarn, the greater its size. Now our designer begins to call on a great deal of additional information concerning the rticular cylinder machine and the type of board to be made. r instance, he notes the width of the machine, since he ows that, all other things being equal, the wider a belt, the ater its pulling strength. Hence a narrow machine with a ugh pull will require a felt with a stronger warp construction an a wider machine with the same tough pull. He notes e type of board to be made. Is felt impression a problem? straw corrugating medium, it probably is not. On food ard it is apt to be since often the sheet may be printed on her top or bottom side interchangeably. He looks to the mber and position of any helper drives which may be on is machine. Additional drives (provided, of course, that ey are properly synchronized) mean less strain on the felt. he can use smaller warp yarns and get a smoother surface the felt. How about water removal equipment—such as tractors, suction drum rolls, suction pipes, suction priaries? Any of these may enable our felt designer to add an tra pick or two, thereby improving the finish without runng too great a risk of drainage trouble. As far as warp conuction in general is concerned, the felt designer builds into bottom felt enough strength to do the job adequately thout going overboard in size of yarn.

The filling presents problems of its own. The wool which used must have several special qualities. It should be a w fulling wool. This enables the felt to be of open conuction and to remain that way during its run on the maine. A fast fulling wool is apt to continue to full or shrink the paper machine and as a result the felt narrows in dth and closes itself up. The wool must be strong. Many w fulling wools are apt to be weak and tender and would wear out quickly. The wool must also be resilient. As the felt goes through a nip it is greatly compressed and it must immediately spring back upon release, otherwise it will rapidly harden and fill up. Filling yarn size depends upon the number of picks to be used and the two are varied inversely to obtain the total weight of filling which our felt designer considers optimum. The reason for removal of felts previously run on this position must also be considered. For instance, if the felts are completely worn out upon removal and the filling yarns are obviously shot, then it may be advantageous to insert some synthetic fibers into the filling yarns to better enable them to withstand abrasive wear. This is often done. If, however, the felts are removed because they are plugged up and hard, then obviously little is to be gained by strengthening the yarns. Some other characteristic of the felt must be altered.

You may have gathered by this time that the felt designer is rather dependent upon his field men for information. This is certainly the case. The field man's job is highly important and he must do his work thoroughly and accurately. That is why you'll probably find that he'll spend quite a bit of time in your machine room talking to the operators, measuring the machine, sketching it, checking it, and just plain staring at it. However, it is to your advantage that he is inquisitive since the greater the amount of accurate information he can gather about your machine and running conditions, the better are your chances of getting a satisfactory felt.

Top

There are similarities between the top felt and the bottom felt. They are both long felts and are about the same width. The 3 and 1 satin weave is usual in both and they both run on the same machine. However, here the similarity ends—and with very good reason. As we have indicated before, the bottom felt is called upon to do a number of jobs simultaneously—power transmission, water removal, conveying of the sheet, etc. The top felt primarily imparts a smooth finish to the top of the sheet and cushions the board as it passes through the various presses together with the sheet and the bottom felt. Since the power transmission requirements of the top felt are much less than for the bottom felt, it can be constructed with less warp strength. While in a bottom felt the warp may comprise 60% of the total weight of the felt and the filling 40%, in a top felt these percentages are reversed. This is due mostly to a reduction in warp weight. The average bottom felt might weigh somewhere around 2.7 to 2.75 oz. per sq. ft. while an average top felt might be around 2.3 oz.

The top felt is usually a finer felt than the bottom. It will have more picks of finer filling. This, plus the smaller warp yarns used, gives the felt a smoother surface. Of course, increasing the pick count closes the felt up, but we can afford to do this since we do not try to suck water through the top felt. It must take water, it is true, but this is more a blotting action. However, we cannot go too far in closing up the top felt, since a plugged and hardened top felt will give operational trouble.

Size is important in considering any papermakers' felt. It becomes especially important when considering the long felts used on a cylinder board machine. Any felt has a certain amount of elasticity, but when the felt is 150 to 200 ft. long, or more, the variations in length at different tensions may be considerable. Much has already been written about the use of a felt measuring wheel, and I am not going to discuss it here. I will say, however, that such a device is very useful to the felt maker in determining how long a felt to make for a certain machine.

Press Felts

There is such a tremendous variation in press felts in use today on cylinder board machines, that I am not going to spend much time on them. Everything from a plain weave pulp felt to a twill super plate press is used, depending upon

the press setup, the finish requirements, speed, etc. There is the same wide variation in felt weight and the number of picks.

CYLINDER TISSUE FELTS

The cylinder wet tissue felt performs many of the functions of the bottom board felts which have been discussed above. It picks up a ply of paper stock from a wire mold, carries it to another part of the machine, absorbs water, and allows water to be passed through it. It also transmits power from one part of the machine to another. There are, however, many differences between the jobs performed by these two felts. For one thing, the power transmission requirements are much less in the cylinder tissue felt. It is a much shorter felt. Where facial and toilet tissue are being made, finish of the sheet is usually less exacting. Since it picks up one ply of stock rather than seven or eight, less water must be removed by and through the felt, but because it is a much shorter felt and usually runs at a higher speed, this water removal must be accomplished faster than on a long felt.

Cylinder wet tissue felts are usually woven endless with a plain weave. They are normally around 2.25 oz. per sq. ft. Porosity and strength are considered more important than finish, although this may not hold true for every cylinder tissue machine now running. Usually, a cylinder tissue felt is thinner than a fourdrinier tissue felt. This is because smaller yarns are used to reduce the prominence of the yarn crossings, since it is here that stock may tend to collect, causing pinholes in the sheet. A compromise must be found between an open felt for efficient water removal and a close felt to minimize felt pattern in the sheet.

There are of course many varying opinions as to the relative merits of making tissue on a cylinder as against a fourdrinier machine. The consensus seems to be that the cylinder is more limited as to speed and that a squarer sheet can be made on a fourdrinier. However, cylinder men say they can make a softer sheet and that their initial installation cost is much lower. I have even had some of them tell me that they can make a squarer sheet than can be made on a fourdrinier. In this paper it will suffice to say that felt companies are now making felts for both types of machines and they will continue to do so, as long as both types of machines are in operation.

SYNTHETICS

In the past 8 or 10 years much interest has been shown by the textile industry in the new synthetic or man-made fibers. The felt manufacturers, too, have looked into these new fibers, for some of them have qualities which are advantageous as far as felts for paper machines are concerned.

For one thing, many of these new fibers are impervious to the action of fungi and bacteria. These organisms have much to do with the short felt life obtained on some paper machines. They are present in all mill systems and exert a rotting effect on woolen felts especially during periods of machine inactivity. This condition is, of course, worse in some mills than in others.

Another advantage of synthetic fibers is their high tensile strength. The value of this should be apparent in view of what has been said earlier in this paper. It should enable the felt maker to reduce yarn size and still maintain the necessary strength.

Many of the synthetics are more resistant to abrasion than wool, and there is abrasive wear on any felt that passes through a press and around rolls, over suction boxes, and past a whipper.

Another characteristic of some of the synthetic fibers is their low water absorption. This has both good and bad points. As we all know, wool takes water like a sponge. As it does so, however, the fibers, and therefore the yarns themselves, swell in diameter. This tends to close up a felt. Synthetic yarns retain their original size, wet or dry. We would expect to get good drainage through yarns of this type since they would not absorb water, swell up, or close up. We have seen, however, that there are places on a paper machine where it is necessary that the felt absorb water. And so it would seem that a hydrophobic fiber is a mixed blessing.

Wool fibers exhibit the unique property of felting or fulling whenever subjected to heat, moisture, and pressure. During the fulling operation a felt shrinks in size, becomes thicker and stronger. This is due to the scales which cover the surface of the individual fiber. In the fulling process these scales interlock with one another and great cohesion is built up between adjacent fibers. Since synthetic fibers have a smooth surface, they exhibit little tendency to felt or full. This would have one advantage in a felt. It would tend to make the size of the felt more stable on the machine. However it has the strong disadvantage of making the felt slippery or sleazy. Since there could be no yarn-to-yarn bonding built up within the felt, the yarns, especially the filling, would tend to creep around within the felt leaving alternate very open and very close areas. Furthermore, to say that slippery yarns present a joining problem would be the understatement of the week.

Synthetic fibers, in general, do not have the resiliency or spring-back of wool. As a felt passes through a press, its yarns flatten out due to the pressure exerted on them. It is important that they spring back to their original shape upon release. Otherwise the felt flattens out and soon fills up and becomes hard. The nap itself must spring back, for if it lays tight against the body of the felt, its value is lost. Stock will become embedded in the felt and trouble may be encountered with the sheet sticking to the felt. As synthetic content in a felt is increased, felt impression becomes more of a problem since the yarns are harder and less resilient due to the synthetic fibers in them.

Stretching becomes more of a problem with synthetic fibers than with wool, since they do not exhibit as much elastic recovery as wool. This becomes quite important on long felts. A long felt must have the property of giving with increased tension, but it must come back when that tension is relaxed. Otherwise the felt will stretch right off the machine.

These are only a few of the problems which must be considered when thinking of synthetic fibers in connection with papermakers' felts. It must be understood that this discussion has been of synthetic fibers in general. Each type of synthetic has properties of its own and each one may have qualities better or worse than those outlined above. As has been stated above, felt companies do have these new fibers under consideration and are experimenting with them all the time. It is realized that anyone who proposes to fortell the future puts himself out on a limb. However, if I were to take such a flyer, I would say that we would probably end up with some sort of blend or combination of wool and synthetic fiber, since to date, both of these have properties which are advantageous in paper felts. They also have qualities which can be improved upon.

CONCLUSION

There are, of course, many other topics which could be included in a paper such as this. Nothing has been said about installing a new felt, felt washing, felt operation, size variation, etc. However, it was felt that it would be better to stick to a few items and cover them fairly thoroughly, rather than attempt to hurriedly touch on all phases of the subject. These other topics have all been covered in previous papers and there is a good bit of information about felts in Volume 3 of the new edition of "Pulp and Paper Manufacture."

Empire State (Eastern District)

More than 100 attended the monthly meeting of the Eastern District of the Empire State Section of the Technical

Association of the Pulp and Paper Industry held Thursday November 19, at Milfranks Restaurant.

The group heard talks on three valuable slants on training programs for the industry. Raoul P. Beaudette, personnel supervisor of the Hudson River mill, International Paper Co. of Palmer, spoke on "Some Practical Aspects of Industrial Training." Another speaker, Harold L. Field, technical director of the Mechanicville mill, West Virginia Pulp & Paper Co., outlined another angle, the technical training program, while Baker Middleton, personnel manager of the Marinette Paper Co., Fort Edward, spoke on "Selecting, Measuring and Developing Men."

Also, Earl Johnson, of the Stevens and Thomson Co. of Greenwich, outlined plans for the Junior Award Contest.

John W. Crocker, Chief engineer of The Sandy Hill Iron & Brass Works, presided over the meeting.

It was announced by Talmadge Edmans, program chairman, that the next meeting would be held December 16, at which time Ralph Kummler of the American Cynamid Corp., should be the main speaker.

ALLEN A. LOWE, *Publicity Chairman*

Some Practical Aspects of Training in Paper Mills

Raoul P. Beaudette

FROM time immemorial, a controversy has been going on between the highly trained technical expert and the practical supervisor. One is apt to claim that since overcoming the force of gravity is a highly technical operation, no one is qualified to buy suspenders before consulting Einstein or some other physicist. The other is apt to refuse to wear suspenders because he has heard someone say they were a scientific contraption devised to overcome the mutual attraction of all bodies for each other in accordance with Newton's Law. In no field of endeavor is the controversy more apparent or more heated than on the subject of industrial training. On the one hand, we have the fellow who believes that you cannot have a training program without a Ph.D. to guide its destiny and on the other, we have the practical supervisor who refuses to believe that a knowledge of psychology is essential to a good progressive training program.

A superficial examination of this more or less useless and energy-wasting controversy will show any intelligent supervisor, be he classed as technical or practical, that this situation should not exist. To the technically trained man with his wholly academic and scientific viewpoint the practical supervisor is indispensable. To the practical supervisor, the scientific knowledge which he can get from the technically trained man is of equal importance. There should be no quarrel between the two but a perfect blending of the two viewpoints for the ultimate realization of any given objective.

In trying to organize training in industry, we are forever coming up against this problem in the form of the person who thinks of training programs in highly technical, formal, and highly developed terms without any regard to common sense, and the other extreme who refuse to believe that there is any need for training at all. As already pointed out both types are a little wrong. Making people *want* to do a job a certain way is the most difficult job in the world, and requires a great deal of thought and effort. On the other hand, since common sense is on the side of the trainer, all he has to do is to teach that part of the job not known by the operator to be trained, and *which is not obvious* but necessary for success. This can be done in a variety of ways and we intend to show you a few simple common sense methods which produce results.

All training programs must start with the formula $A - B = C$ where: A = the knowledge and skill required to do a job efficiently; B = the knowledge and skill the operator already has; C = the knowledge or skill he must acquire.

RAOUL P. BEAUDETTE, Personnel Supervisor, Hudson River Div., International Paper Co., Palmer, N. Y.

C in any given job is the "gimmick," that hidden little something which "makes or breaks the job."

Allow us to give a scientific explanation of a very common "gimmick" which makes or breaks a common daily operation.

A private secretary is allowed 20 min. for lunch provided by the employer, a substantial part of which is a large bowl of delicious, healthful, hot, but very hot, soup.

This soup is rightfully served in a heavy bowl made to keep the soup hot as long as possible (Standard Practice XYZ). With it is given the largest spoon ever put on the table. Using our formula: A = she is required to eat lunch including hot delicious soup in a given time; B = she knows where to go to get lunch, she knows if she doesn't eat all of it she may be hungry later on, she has ample time for part of the lunch, but she takes more time than is allowed for lunch on account of the soup being too hot; and C = she does not know how to eat hot soup in the shortest possible time, without burning her mouth.

Now using a projector which we wish to demonstrate as a practical, simple, and easily operated visual aid, which can be used to help industrial training, let us find the "gimmick" which will lead to success.

Series A—Showing How Usefulness of Heavy Spoon to Control Temperature Is Destroyed

Picture 1—Clock at 12:30; temperature of soup 200°F.; secretary stirring soup with spoon
Picture 2—Clock at 12:35; temperature of soup 150°F. in bowl; temperature of soup 148°F. in spoon; secretary blowing on soup
Picture 3—Clock at 12:40; temperature of soup 140°F.; secretary eating soup
Picture 4—Clock at 12:45; secretary done with soup

Series B—Showing How to Control Temperature of Soup at Mouth with Spoon

Picture 1—Clock at 12:30; temperature of soup 200°F.; secretary holding spoon away from bowl
Picture 2—Clock at 12:31; temperature of soup in bowl 180°F.; secretary taking soup, a small amount at a time; temperature of soup in spoon 138°F.
Picture 3—Clock at 12:36; secretary done with soup

The "gimmick" is the heavy spoon and how to use it. When it is submerged in the soup, it very rapidly reaches its temperature and immediately loses its usefulness as an instrument to control temperature. Its usefulness can also be in part destroyed by holding it over the hot soup. The idea, as shown, is to take up just enough soup with the spoon that the heat will be absorbed by the metal on its way to the mouth, and cooling the spoon before taking another spoonful. By experimenting it is possible to regulate the temperature as wanted. Every chef, cook, and most housewives know this and use this "gimmick" every day. We have no intention of canvassing this group to find out how many people here knew this. We do know that a large percentage of people who eat soup, often for a whole lifetime, do not know it. They prove they don't know how to cool soup efficiently by stirring it, blowing on it, or just plain waiting for it to cool. This is good as long as there is no time limit. In industry, however, there is *always* a time limit. Before people can eat soup "efficiently" they must be shown the simple "gimmick" which enables them to do so. So it is in industry. Simple? Yes, simple but highly scientific and technical since in this case it involves the thermal control of latent heat by using metal to remove B.t.u.s and dissipating them by convection and radiation in the atmosphere! Thermodynamics, aerodynamics, metallurgy, etc., are all involved.

The most important step in job training, then, is to find the not so obvious "gimmick" which is usually well known by someone, but is not known to the operator. You have already seen how pictures and the projector, a simple cheap apparatus, was used to show a group quickly and effectively just what was needed for success in a given situation. Let us see how this and other simple visual methods can be used to help the training program in a plant (see Appendix).

Addressing mail
Chlorine injector
Hot water hoses
Unloading laps
Blowing digester
Operating trimmer

The technically trained individual who approaches a problem scientifically ceases to be "scientific" when he fails to take into consideration the important factor of practical experience in arriving at a solution. The man of practical experience ceases to be "practical" when he does not recognize that even the simplest operations and relationships are based on complicated and sometimes obscure laws of nature.

From a practical aspect the line supervisor is the only one in a position to see to it that the men he supervises are properly trained. He knows from experience that industrial training is not like catching a bus and then riding to a destination. Too many times he has seen demonstrated that knowledge on the part of the operator is no guarantee that a job will be done accordingly. He knows that industrial training is a continuous process summed up in one sentence—"teach the job as it should be done and see to it that it is done that way every time."

The varied, numerous, and complex problems which daily face the practical supervisor in modern industry make it necessary for him to obtain technical help. He must make use of every modern aid available to him, be they engineering skills, or mechanical aids such as some we have seen. His admitting that he needs help does not reduce his prestige or in any way indicate that he is inadequate as a supervisor. On the contrary, it shows that he recognizes the need for technical development based on scientific appraisal. The intelligent use in his department of the scientific knowledge, engineering skills, and equipment provided will not only increase departmental efficiency, but since efficiency is a measure of his supervisory ability, this increased efficiency will enhance his value to the organization and cannot help but increase his prestige as a supervisor in the eyes of the people he supervises.

This does not mean that all simple and practical methods should be "junked" in favor of highly complicated theoretical methods. It simply means that, particularly in developing a training program, the practical must meet and combine with the technical to develop a simple workable program which will enable every supervisor to do his job better by training his people to work with the maximum efficiency.

APPENDIX

Addressing Mail

Problem

Quite often our mail is missent to Corinth Postoffice instead of Palmer Postoffice. This causes a delay of 1 day in receiving first class mail, and for other classes maybe longer as only first class mail is forwarded. All other mail has to be picked up which is costly. This matter also causes inconvenience to the Corinth Postmaster.

Cause of the Inefficiency (the "Gimmick")

We operate a plant situated in the village of Corinth in the town of Corinth. However, we receive our mail at the Palmer Postoffice which is situated about 1.2 miles from the Corinth Postoffice but is also in the village of Corinth. This situation is unusual and makes it very easy for our correspondents to assume our mailing is rightfully Corinth.

Remedy

All persons who have outside contact should make sure that:

1. When making new contacts that correct address be given.
2. Notify correspondents at once of correct address when asked to do so.
3. When the corrrespondent involved is known personally it is recommended the form used be personalized. This promotes better and friendlier feelings between companies and insures that the proper party will get the information.
4. Use forms provided for the purpose, obtainable through the regular channels.

Chlorine Injector

Job

Chlorinating milk of lime to make calcium hypochlorite bleach liquor.

Problem

Be able to tell when car is nearly empty and be able to get *all* of the chlorine out of it.

Actual Operation

A log is kept of the amount of chlorine taken out of car. When this indicates that car is nearly "empty," the operator is trained to watch for air bubbling out of solution. When this occurs he is to open chlorine regulating valves wide, thereby making sure that all the chlorine in the car will be used. On one occasion serious trouble was caused by over-chlorinating when an operator, who knew trouble had been experienced during the time the car was being used, mistrusted the log and when gasification ceased, assumed the car was empty, opened the valves wide.

Remedy (the "Gimmick")

Frost on the vapor loop will tell a story.

1. Vapor loop will defrost where (a) chlorine stops coming or (b) *liquid chlorine* flows through loop.
2. When liquid chlorine vaporizes in car, which it does when car is becoming empty, frost sometimes forms *below* valves.

Hot Water Hoses

Situation

One day an employee reported to the first aid room with a very mild burn on his back. Investigation showed he had been burned on a "cold water" pipe furnishing water to a steam injector.

Cause (the "Gimmick")

Improper installation of hot water hose.

Remedy

The picture shown was used to motivate all supervisors including safety to:

1. Inspect every department for similar condition.
2. Install hot water hoses properly.
3. Remove or re-install those found defective.
4. Make the subject "hot water hoses" a part of the regular monthly inspection sheet.

Unloading Laps

Situation

Pulp received at the mill in sheets piled on skids but not bound was badly "scrambled," hard, and dangerous to unload.

Problem

To speed unloading operations and reduce hazard of unloading.

Remedy (the "Gimmick")

The idea of taking certain stacks of the sheets out by hand instead of trying to use the lift truck speeded up operations greatly.

A picture was taken and enlarged to 20 by 30 in. and used y the foreman to the head laborers, who in turn used it with heir particular "gangs." This picture showed how to do the ob properly. It also served to focus attention and interest of ll concerned on the problem, and dissipated the attitude that othing could be done about it.

lowing a Digester

GIMMICK": PROPER SEQUENCE OF OPERATION

1. Close relief valve. (To prevent gases from separator lling digester while it is being blown or after blowing. If his occurred serious "gassing" would occur in the digester ouse.)
2. Open blow valve.
3. Open blow back steam valve.
4. Remove every other bolt on head.
5. Open end steam.
6. Close blow-back steam valve.
7. Remove digester cover when digester is completely mpty.
8. Put in chip packer, hopper, and get ready to fill di- ester with chips.
9. Close end steam. (Failure to do this before starting to ill digester would fill blow pipe with chips causing difficulty nd lost time.)

perating Trimmer

OB

Trimming wrapper heads.

ROBLEM

Danger of amputation from knife.

GIMMICK"

Keep operator aware of extreme danger from repeatedly eaching near blade before it has returned to still position.

1. Shows both hands being used to start trimmer.
2. Shows small trimming forming *out* on apron after cut.
3. Shows blade returned to still position.
4. Shows operator having let go of left handle and reach- g onto trimmer to prevent jarring out of trimmings with lade in downward motion.

mpire State (Metropolitan District)

About 70 members and guests were present at the Nov. 10, 953, meeting of the Metropolitan District, Empire State ection of TAPPI, held at Fraunces Tavern in New York ty to hear a panel discussion on Flexographic Printing. rving on the panel were Robert K. Zuckerman, manager of e New York office of the Kidder Press Co., John Lecraw, ant superintendent, Mosstype Corp., and Joseph W. Viner, ce-president, Printing Ink Div. of Interchemical Corp.

All the talks were illustrated by numerous examples of xographic printing on a number of different stocks. The ry interesting question-and-answer period which continued e discussion for over an hour, showed the keen interest in e subject. A summary of the talks follows.

Flexographic Printing Inks

Joseph W. Viner

FLEXOGRAPHIC printing was, until recently, known as niline printing," from the "aniline" dyes which gave color the early inks used for rotary rubber plate printing. These inks were simply dyes dissolved in alcohol with shellac serving as a binder (and giving some finish). They were easy to make and proved popular because of the brilliant colors and ready solubility of the "aniline" dyes.

The flexographic principle of rotary rubber plate printing demanded (and still demands) inks in liquid form rather than the paste inks used in other letterpress processes, as well as in lithographic printing. This demand for fluid inks led to the development and use of the early "aniline" dye inks despite their shortcomings. They dried almost instantly after printing and produced acceptable quality for the type of work on which they were originally used. Most of this work was limited to the printing of porous paper stocks for conversion to bags and wrapping papers.

All early flexographic inks lacked finish and opacity. And none of the colors were lightfast. Lack of finish was not too important then except in a few limited applications. But ink transparency and fugitive colors were serious defects. Little could be done about the latter as long as dyes were used. However, opacity was first achieved by adding titanium dioxide to the dye solutions. This was done by grinding the white pigment in shellac (or some similar vehicle) and mixing it into the alcohol and dye.

The first flexographic dye inks had other defects. Many of the colors bled in water while any one of them was apt to bleed into a second color when overprinted. They were temperamental in other ways, too. The alcohol evaporated rapidly in the open fountains used and quickly absorbed water from the air on humid days. The importance of keeping flexographic inks water-free (to prevent precipitation of resin content) was not always realized.

The development of opaque flexographic inks came shortly after cellophane made its bow in the packaging field. Converters soon found that flexographic printing was a "natural" for this new material. Then in the early 1930's, the volume of flexographic printing reached a point where it drew the interest of printing inkmakers. From this point on, the old dye inks were on their way out. Scientific research and experiment soon led to entirely new and different inks for rotary rubber plate printing.

At least 80% of today's flexographic inks are pigmented. They consist of finely ground pigments dispersed in a solution of solvent (primarily anhydrous ethyl alcohol) and varnish. These inks are fluids, not pastes, and may be shipped to printers in concentrated (toner) form or ready for the press. They dry mainly by evaporation, frequently with some degree of absorption, depending upon the stock used.

Pigmented inks may be had in various degrees of opacity and in all colors. Pigments used are the same as those used in other letterpress, offset, and gravure inks. But they are compounded differently. Lightfast colors are available just as they are in inks for other processes.

Since pigments are for the most part insoluble, they must be finely ground to remain suspended in the solution of solvent and varnish. The finished pigmented ink is a well-balanced formula needing reasonable care at the press for best results. Color strength and printing quality are built into the ink. They must not be disturbed by careless dilution.

Dye inks of the flexographic type consist of dyes in a solution of solvent and varnish. Mainly the basic alcohol-soluble dyes are used—with some exceptions for special jobs. These dyes are largely derived from coal-tar intermediates, and cover the entire hue circuit.

All dye inks are transparent and most of them are fugitive to light. The few lightfast dyes existing do not cover a full color range. Being transparent, dye inks blend readily to make other colors in overprinting. However, they may bleed into each other to some extent if the printer is not careful. Bleeding is also apt to occur when a pigmented white overprints a dye color if both inks have a common solvent, such as alcohol. Printers should always test mill-dyed paper

SEPH W. VINER, Vice-President, Printing Ink Div., Interchemical Corp., w York, N. Y.

to see if it bleeds into flexographic inks, since such a bleed may affect the shade of the finished printed job.

The solvents in flexographic inks control the drying rate. Proprietary grade anhydrous ethyl alcohol is by far the most popular flexographic ink solvent. It evaporates rapidly (boils at 78.1°C.), is nontoxic and practically water-free. The water content of nonanhydrous ethyl alcohols may precipitate the gums and resins used in flexographic ink vehicles, since these gums and resins are not usually compatible with water.

Pure synthetic methanol is a useful solvent for certain work. It evaporates more quickly than ethyl alcohol (boils at 64.5°C.), but the fumes are toxic and highly flammable. The fast evaporation rate may cause excess moisture to be condensed into the ink, particularly under conditions of high temperature and humidity.

Butyl alcohol also finds occasional use in flexographic inks. It is a relatively slow drying solvent (boils 117.7°C.) but has the advantage of being only partly miscible with water. It has a sour, pungent odor which limits its use considerably.

Cellosolve (boils at 135.0°C.) serves to retard the drying rate of flexographic inks when used with ethyl alcohol. As a rule, it should be used in small quantities only.

Water also serves as a solvent in certain flexographic inks of the emulsion type. These are frequently used to print on relatively porous stocks. Actually, the water is not usually present in the ink as a true solvent, but with varnish and emulsifier, makes an emulsion with the pigments. In this case, initial drying is largely by absorption. Water-emulsion flexographic inks may be used for work demanding low-cost printing on stocks porous enough to readily absorb the water in such inks, but they are frequently used where press stability or freedom from fire hazard are important considerations. Such inks are not intended for gloss or finish, but are excellent where a velvet, matte finish is desired.

All solvents listed so far may be used with natural rubber rolls and plates, but there are some which require synthetic rubber. One such type of solvent is the family of aliphatic hydrocarbons. Inks using hydrocarbon solvents are occasionally used for certain special types of work. Here again, initial drying may be by absorption, as well as by evaporation.

Special printing problems may also call for other solvents needing synthetic rolls and plates. Pliofilm and vinyl films may furnish a typical example. To print these films, it might be desirable to use ink solvents which act on the surface of the film itself, and to do this, solvents which affect natural rubber rolls and plates, might be required.

Many other solvents might be used for flexographic inks but their drawbacks usually outweigh their good points. Carbon tetrachloride, for instance, is fireproof, evaporates quickly, absorbs no water from humid air, and readily dissolves many resins and gums. However, "carbon tet" gives off highly toxic fumes and dissolves and/or swells most rubber compounds used for printing plates and rollers.

Most varnishes used in flexographic inks are made of alcohol-soluble resins and gums. They are not compatible with water and will precipitate if the ink absorbs too much moisture.

The gums and resins in each varnish determine the gloss and other properties of ink. They help the ink to bind on hard surface stocks and aid in developing adhesion to special films.

Another function of the varnish is to help keep the finely ground pigment in suspension and carry it to the printing plate. Varnish may also be applied, as such, over a printed surface for extra gloss and protection. If used for overprinting, it must not redissolve the ink vehicle to cause bleeding. And the resins and gums must sometimes be chosen for nonyellowing properties, or other special requirements. Special gums and resins give "slip" to flexographic inks so that printed surfaces "slip" or slide over each other without scratching or marring. These are often called compounds in the trade. Plasticizers may also be added to inks for extra flexibility when called for.

Pigments for flexographic inks are the familiar whites, blacks and all colors (organic and inorganic) used in other types of inks. They are finely milled to produce the best printing properties in a fluid ink.

A general line of pigments is used for regular printing where no particular requirements are specified. Then there are special pigments where extra gloss, light permanence, lack of odor, bleed resistance, or alkaliproofness is specified. Still others must be used for butter or bacon wraps and for similar food package work.

As in all printing methods, pigments used in the flexographic process are chosen to meet individual problems. The more requirements specified (as alkali or lightproofness) the more limited the choice of pigments and range of colors.

Six printing factors decide whether or not a job is best suited to the flexographic process. They are:

1. Stock—can it be printed on rotary, web-fed presses?
2. Design—is it practical for rubber plates?
3. Printing surface—is it suited to flexographic inks?
4. "End-use"—do flexographic inks meet specifications for the end use?
5. Other conversion steps (as slitting, creasing, folding, scoring—do they follow immediately after printing?
6. Economy—flexographic cost is low, efficiency high.

All of these factors should be checked when comparing flexographic printing with other processes. Any one may swing a job to or from flexography.

Speed of printing (and ink drying), versatility, low cost plates and presses may appear to be added factors. But they are all a part of the six points listed above. As for quality—that of today's flexographic printing is excellent for work in its own field. And that field is growing daily.

Soft, absorbent paper and board print best with inks which dry by absorption. Stocks of this type are used for napkins, tissues, Christmas wraps, box wraps, shopping bags, low cost forms and labels, wallpapers, wallboard liners, paper towel wraps, and various kinds of folding boxes (such as chipboard laundry boxes).

Water-emulsion type inks are well suited for a wide range of absorbent stocks. They are low in cost, practically odor free, set rapidly, remain stable on the press, and come in most colors (as well as whites and blacks). Such inks give a velvety, matte finish.

Flexographic inks with aliphatic hydrocarbon solvents produce excellent low-cost printing on many soft, absorbent stocks. These inks have very fine printing qualities and offer a complete range of colors. They are free from objectionable odor, set quickly for immediate rewind, are remarkably stable on the press and require no release of impression cylinders for even the longest shutdowns. Also, color remains uniform throughout the press run.

The hydrocarbon solvents are hydrophobic and are thus repelled by the moisture content of porous stocks. This action steps up mileage by tending to keep the ink on top of the stock. Color does not strike into the inner stock fibers as readily as it does with alcohol or water type inks.

Synthetic rubber rolls and plates are required to run hydrocarbon-solvent inks. But they may be used on any standard flexographic press so equipped.

Hard surface stocks demand inks which dry by evaporation. Stocks of this type are glassine, metal foils, and the various cellophane films. Plastic films come under the same heading although many of them are really soft to the touch (as are pliofilm and polyethylene). Printing of these stocks calls for skill on the part of both printer and inkmaker.

Inkmakers produce special inks for hard surface stocks. Pigmented flexographic inks are most often used. These consist of pigment, solvent, resin, plasticizer, and often a compound for gloss, slip, or other special property. The solvent is usually proprietary grade anhydrous ethyl alcohol.

Glassine bags are often printed with dye inks made of dyes, olvent, and varnish. Compounds for gloss and slip may also e added to these inks.

Some plastic films, such as polyethylene, require an "anchor oat" (also applied on flexographic presses) or some other rt of surface treatment, for best adhesion of ink to film. here an "anchor coat" is used, this coat is applied to the film st and provides a mutual bond between the film surface id the inks. Various surface treatments are used to render ich surfaces as polyethylene, receptive to inks.

In the bag printing field, kraft and sulphite stocks are often inted with dye inks, where lightfastness is not required. ich inks are made with selected dyes, solvents, varnish, and ose resins or compounds needed for special properties (such s rubproofness, gloss, etc.).

Pigmented flexographic inks may also be used on kraft and lphite stocks if desired. They are a matter of course where pacity and lightfastness are wanted, and these pigmented ks may be of either the solvent or water-reducible types.

The flexographic process is a natural for applying coatings id over-all tints to all types of papers, boards, cellophane, id plastic films. Plain rolls of either natural or synthetic bber replace the printing plate to apply a smooth, even m to the stock.

Coatings of the flexographic type have suddenly changed e entire complexion of the container printing field. They e used to hide the typical brown or tan surface of container oard stock. As a result, customers may now get brilliant, l-over background colors at low cost. Each container can ve its own identity apart from the printed design. And w color schemes are now possible—schemes which were lled by a tan or brown background.

Flexographic coatings are pigmented for opacity and made meet the needs of each job. They consist of pigment, var-sh, solvent, and added gums or resins as called for. Some e compounded for extra gloss and color strength. All atings must present a good printing surface to accept the ks which follow.

Some flexographic tints are made of dye, white pigment, lvent, and varnish. An all-dye tint (without pigment) is nsparent and is generally used for white or very light stocks ly. Dry tints will not show on stocks darker than the tint elf. Light-colored coatings are often called dye tints but ost of them use some pigment. Where lightfastness is cessary, 100% pigment formulations are used. And the gments are specially selected for permanence in light tint.

Colorless coatings which bind inks to some plastic films e also applied on flexographic presses. They are called nchor coats." This type of coating forms a bond with the m and then with inks printed over it. Solvents, gums, sins, and special compounds are chosen to suit both the film d the inks. Anchor coats must be as clear as the film elf and stay clear over a period of time.

Flexographic varnishes have been mentioned under resins d gums. They are usually clear or "water white" as the ade calls them. Varnishes may be made from almost any sin which can be dissolved in solvents suitable for flexo-aphic printing. Even plastics (such as vinyl) are some-nes used. The gums, resins, and other contents are picked give gloss and protection or functional properties such as at sealing, water or greaseproofness, etc.

Some types of lacquers are also in the flexographic family. ney may be true nitrocellulose lacquers or other types with sired decorative and/or functional values. Lacquers and rnishes often serve the same purpose. And both need re in their choice for each job.* Solvents used in overprint cquers and varnishes must not redissolve the inks when inted over them. Varnishes are often applied immediately ter printing by the last unit of the press. In such cases, e printing is normally heated or otherwise at least partially ied before reaching the varnish unit. This drying helps to keep the inks from redissolving and bleeding in the varnish or lacquer—even if the solvents for both are of the same family.

All flexographic inks (both pigmented and dye types) need careful handling at the press for best results. So do flexographic coatings, varnishes, and lacquers. Their well-balanced formulas should be kept as constant as possible until they leave the printing plate. Covers for fountains and rollers are just as important as covers for kits and drums. Solvent lost by evaporation must be replaced to maintain color control.

All inks should be tested for printing properties before adding solvents (or anything else). Too much solvent will spoil the ink. Each addition should be checked to make sure it is right for that particular ink. The same care is needed when mixing dye inks with pigmented inks to get another color. They should be of the same solvent and binder family.

Constant agitation of flexographic inks is another must for good color control. Ink pumps supplying the fountain from closed kits, drums, or tanks are recommended. These keep the ink in motion at all times. They also permit solvent addition to the ink reservoir instead of to ink in the press fountains.

A recent development for the automatic control of ink viscosity now makes it possible to maintain any desired viscosity in a flexographic ink, throughout an entire run, and even from one run to another, automatically and with extreme precision. The use of such a device makes possible a degree of uniformity and dependable, foolproof duplication of results, which opens a whole new field of quality applications to the flexographic process. The use of such units is most desirable in connection with any long run jobs where consistent quality and uniformity are important considerations.

With fast drying flexographic inks, rollers should never be left in contact with the web when a press stops. The rollers should be backed off at once and printing impression not applied until the press is rolling.

Flexographic printing of uniform quality (throughout press runs) demands ink films of uniform thickness. These are not easy to maintain with ordinary flexographic fountain rollers. However, there are mechanically engraved metal rollers which pick up a measured film of ink and transfer it to the printing plate. Thus the ink film thickness is much less dependent upon press speed and other factors. These improvements are characteristics of the "Anilox" process.

In multicolor work, light colors should always precede darker colors. There is then less change of color change in the second unit (due to slight ink transfer from the first impression to succeeding plates and ink rollers). This is because a small amount of light colored ink has little effect on darker colors. But light colors are sometimes thrown off shade by the pickup of minute traces of dark inks from the first printing unit.

Clean fountains, pumps, rollers, and containers are of prime importance to good flexographic printing. Use the proper solvents liberally to keep the press as clean as possible. Pressmen should be extra careful to remove all traces of one type of ink before running another.

Flexographic printing is now the backbone of a large part of the packaging field. It permits low cost printing of good quality for many industries. Since 1939, use of the flexographic process has jumped more than tenfold. It is the fastest growing process in any printing field.

In theory, flexographers are limited in their work only by the limitations of rubber plates. In practice, the flexographic process is not yet fully adapted to fine screen and hair-line register work. But with proper design, almost any job can be printed with flexographic presses. Stocks are no longer thought to offer any serious problems. Even the most troublesome plastic films have been printed successfully

with flexographic inks—as well as (and often better than) by any other process, and at less cost.

Because flexographic printing is so well suited to package printing, its other possibilities are underplayed. This is only natural. The vast packaging field has such a vital interest in flexographic methods that the influence of others is dwarfed by comparison.

Like offset, gravure, and other letterpress processes, flexographic printing has its own domain in the graphic arts. But right now, the extent of that domain is unknown. Until the process stops mushrooming in packaging and allied fields, the rest must wait. So far, flexographic press builders (and others in the industry) have had their hands full with package printing demands.

It is true that business forms and similar jobs, as well as some publication work, are rolling off flexographic presses right now. Even newspaper, additional publication work, and poster printing are considered inevitable future applications. Quality flexographic printing is now a reality with the "Anilox" system of uniform ink distribution. And, refinements in the process may soon solve the problem of fine screen and hair-line register work.

Flexographic Printing Presses

Robert K. Zuckerman

"FLEXOGRAPHIC PRINTING" is the new name being universally adopted for what was originally called "aniline printing."

Basically, flexographic printing is a letterpress operation—printing is done from raised type—fluid ink being applied by a form roller to rubber plates which transfer the image against a steel or rubber-covered impression cylinder.

Almost all flexographic printing being done today is rotary web printing, and all of our discussion tonight will be based on this type of operation.

The printing section of a flexographic press is extremely simple. It consists of four rollers. There are two ink rollers, one of which revolves in the ink and furnishes it to the second roller which deposits the ink onto the printing plates. Pressure between these two rollers distributes the ink. The third roller is the one on which the rubber printing plates have been mounted. The last roller in the series is the impression cylinder. There are variations, such as single roll fountains with doctor blades—which we will not discuss tonight for the sake of simplicity.

The ink rollers and impression cylinders are of a fixed size, but the plate cylinder can be of any size within the range of the press, which usually is 2 or 3 to 1. That is, a press having a minimum printing repeat of 10 in. will take a maximum of 30 in.

Herein lies one of the basic differences between flexographic and other types of web fed or sheet-fed letterpress equipment—the ability to vary the printing repeat as needed, usually in steps of $^1/_4$ in. more or less.

Since the plate cylinders are always being changed, while the ink rollers and impression cylinders are not, it follows that there is no fixed ratio between the diameters of these moving parts, except that they have a uniform surface speed.

Provisions for moving the ink rollers to the plate cylinder and the plate cylinder to the impression cylinder, and means of exerting pressure between the ink rollers constitute the printing adjustments. For multicolor printing, means are provided for sidewise and lengthwise registration.

Several printing units of this type may be combined in a single frame. Presses with as many as six colors are being built regularly as standard equipment. The usual arrangement is to place the units over one another and opposite to one another, so that a four-color press will have two sections over two sections with the web traveling down on one side of the press for the first two colors and up on the other side for the other two colors. This setup is known as a stack-type press. A modification of this design has all of the colors printing against a common impression cylinder.

Another type of press known as the unit type is built with each color housed in a separate frame—these colors are then placed in a line for multicolor printing.

Presses of either type may be built in any width. At the present time I believe the maximum is in excess of 100 in.

The material to be printed, which varies from tissue 4 or 5 lb. to the ream, to 30 and 40-pt. board, and includes such stocks as cellophane, polyethylene, vinyl, and similar plastics, is supplied in rolls varying from 9 to 70 in. in diameter.

Various types of roll stands are provided, from a simple cradle with manually operated tension, to flying splice equipment with complete electronic controls similar to those used on newspaper presses.

After printing, the web of material may be rewound, fed directly into a bag-making machine, cut into sheets, or die cut into boxes, milk cartons, or some other products.

Where the printed material is being rewound, various methods are employed according to the construction of the equipment and the nature of the product. The simplest type of rewinder consists of a slipping belt type of drive with such variations as flying splices, and several types of constant tension rewinders, which may be mechanically, hydraulically, or electronically operated.

Modern, high-speed flexographic presses are equipped with some means of drying the ink. Partial drying is effected between each color and complete drying after the final color has been printed. Most presses perform the drying operation by blowing heated air upon the web, the air flow being directed in the opposite direction to the web travel. There are other methods, such as the application of superheated steam to the traveling web, or infrared heating, but the hot air method is by far the most popular, and most widely used.

For the printing of cellophane, in addition to the hot air an open gas flame is usually employed. The web travels through or over the flame after being exposed to the hot air. The high temperature of the flame softens the coating on the cellophane so the ink may form an effective bond. Since the inks that are used tend to be softened by high temperatures the web should be cooled by passing it over a drum with circulating cold water before the material is rewound.

There we have a flexographic press, a printing section of one or more colors, provisions to hold the stock to be printed, a means of rewinding or in some other way taking up the printed material, and a means of drying the ink.

From here on in we go into refinements for good quality and high speed.

Infeed systems are provided to insure good register for multicolor printing. The function of the infeed system is to synchronize the surface speed of the web with the surface speed of the printing plates, particularly when the press is accelerated or decelerated.

In the printing section, ink pumps can be supplied to provide a constant flow of ink at all speeds, for better uniformity of color throughout the run.

The upper fountain roller, which you will recall supplies the ink to the printing plates, can be a mechanically engraved metal roller to secure better ink distribution. This method, known as the Anilox method, is widely used.

Means can be provided for engaging or disengaging all printing plates at one time from one position, for such periods when the press is not printing. Another refinement enables the fountain rollers to rotate when the press is idle. This action is used to prevent the ink from drying on the rollers. Both of these functions can be combined. The action may be either mechanically or hydraulically operated.

ROBERT K. ZUCKERMAN, Kidder Press Co., Inc., New York, N. Y.

Rotary register controls can be motorized so that all corrections can be made from one or more control positions on the press.

Viewing devices have been perfected which permit the operator to examine the printing while the web is moving at high speeds.

The list of refinements which can be added to presses goes on without end, since new ideas are being developed all the time.

Flexographic printing, the same as any other method, has its advantages and disadvantages. Perhaps the chief advantage of the process, the one which contributed most to its rapid growth in the past 10 years, is its ability to print on cellophane and similar nonporous materials. The demand for high-speed multicolor printing on materials other than paper for the packaging field has been the greatest stimulus to the improvement of equipment, supplies, and techniques in this field. These developments have made the equipment desirable for other applications where the following advantages were quickly recognized.

1. No press makeready—By using a makeready machine it is possible to set up multicolor plates in register while the press is in operation.
2. Long plate life—Experience has proved that properly made rubber printing plates will outwear electrotypes. As many as 10 million impressions per plate have been run without any sacrifice of printing quality.
3. High speeds—Since as many as six colors are being printed at one time, at speeds ranging from 300 to 800 f.p.m. great economies can be effected. Since a flexographic press has no reciprocating actions, maximum production is obtained, the press printing all the time as compared to conventional presses, which print intermittently.
4. The original equipment is comparatively low in cost—A flexographic press for any width is usually cheaper than other types of printing equipment, the cost of additional colors over the first one is very nominal.
5. Continuous printing can be done—A plate roller of any circumference can print a continuous pattern which can be cut to any length.
6. The printed stock can be supplied in rolls—this has become an important item with the development of high-speed wrapping and packaging machinery. Paper stock supplied in rolls is usually cheaper than when supplied in sheets. For long runs this can be a considerable saving.
7. The quick drying feature of the inks enables the operator to see the end result immediately after printing—it makes possible secondary or inline operations without any waiting period.
8. Solid, brilliant colors can be very readily printed on flexographic equipment. Many paper mills use this method to color small runs of paper stock. They are able to obtain results that cannot be duplicated on the paper machine.
9. Under certain conditions it is possible to print on both sides of the web at one time. Safety papers, decorated writing papers, and envelopes are printed at paper mills on presses arranged for duplex printing.

One of the best things to be said for a flexographic press is the flexibility, and I don't mean to pun. I don't know of any other piece of printing equipment which lends itself to a greater variety of applications.

There have in the past been a few disadvantages to flexographic printing and while they are being overcome might be noted:

1. The over-all quality, especially for fine type matter and other delicate areas is not as good, on the average, as the best letterpress, gravure, or offset work.
2. The printing of halftones is very limited. Constant improvement is being made and some of the more quality conscious and most experienced plants are doing some halftone work. Process printing, although done occasionally, is not yet recommended for this method.
3. Small runs do not lend themselves to this process. The stock as previously mentioned must be supplied in roll form, and while cellophane may be obtained in any quantity in any width this is not true for most grades of paper.
4. The fountains on a flexographic press cannot be split as in a letterpress. This disadvantage is somewhat offset by the low cost of additional colors.

It should be pointed out, however, that the original disadvantages to the process are being rapidly overcome with improvements in presses, plates, and inks and with added experience.

Flexographic Printing Plates

John Lecraw

The introduction of flexographic printing to this country a little over 20 years ago (it was originally called "aniline printing") also brought with it, necessarily, a need for rubber plates to use with the highly volatile inks on the new rotary presses. In those days very little consideration was given to the plates. If they were made of rubber they met the requirements and, if the printing result was somewhat less than good, this was shrugged off simply as a "limitation of the method."

But the last decade has seen rapid progress in the development of presses, inks, paper, and plates. Thus today instead of finding "limitations" in the use of rubber plates and aniline inks the converter regards them as indispensable to the achievement of results that are either impossible or impractical to obtain from other reproduction methods.

The primary reasons for rubber plate printing's wide acceptance among converters include high rate of production, low cost per impression, and outstanding quality on a wide range of hard-to-print surfaces.

Soft, thin, fast-drying inks transferred by kiss impression from rubber plates commonly afford production of more than 1000 multicolor impressions per minute without a trace of offsetting or embossing.

Many factors contribute to the economy gained from the use of rubber plates: Saving of makeready time, reduction of ink consumption and metal investment, elimination of smash-ups and batters on type, less wear and tear on presses, and low cost of duplicate plates. Then, too, rubber plates outwear metal and, if made and handled properly, will deliver in excess of 1,000,000 impressions.

Printing quality obtained from rubber plates rates high on the list of reasons why converters have switched to this method of printing. Adaptable to any kind of stock, rubber plates are particularly effective in printing difficult surfaces like cellophane, acetate, pliofilm, foil, metal glass, glassine, tissue, waxed and parchment papers, cardboard, etc.

On hard, rough, and grained surfaces as well as on smooth films, rubber plates afford a more intense and uniform ink spread, resulting in reproduction of solids and brilliant colors without mottling or alterations. Recent developments in the molding of rubber plates now permit exceptionally sharp reproduction of small type, serifs, thin lines, and coarse screens in positive or reverse.

Molded rubber plates today are made for use on flatbed, web, or rotary presses, sheet-fed or roll-fed, with aniline, oil, or water color inks. They are used for one-color or multicolor register and even for coarse-screen color work. Although they are employed extensively for printing glass, metal, and fabrics, the paper converter uses them in making bags, wrappers, labels, gift wraps, papeteries, box coverings, ruled forms, security tints, carbon papers, envelopes, corrugated boxes, and all other paper specialties. They are frequently used for general commercial printing, too, but this application of rubber plates holds little interest for the converter.

Today the greatest number of impressions from rubber plates occurs in the production of flexible packages or wrappings of cellophane and glassine. The increasing availability of paper, the execution of war-delayed plans, and the growing competitive situation all have resulted in a greater than ever demand for new, brilliant, eye-compelling wrappings

John Lecraw, Mosstype Corp., New York, N. Y.

and containers for foods, drugs, cosmetics, and everything else that is packaged in paper.

Armed with new facts about consumer buying habits at the point of sale, package designers are causing many familiar products to blossom forth in more modern, more attractive, more effective dress. Of course, the introduction of many new products by old and new manufacturers is helping to pace this progress. Thus upon the converter falls the responsibility of producing these new packages quickly and economically, while meeting the quality standards demanded by today's merchandisers.

Gift wrappings, decorative papers, and box coverings also rank high on the list of paper products printed from rubber. Here again rubber plates or design rollers with all-over patterns, fill the need by virtue of the high press speeds, general economy, and even brilliant solids they afford.

Wear and tear on presses and economy in elimination of metal, plus the absence of embossing or punch-through, are prime factors in the use of rubber plates for printing forms, tints, carbons, napkins, etc. Corrugated boxes, poasters, wallpapers, drinking cups are among many other products printed from rubber. As conscientious research continues, such as is being undertaken currently in the folding box industry, we shall see an ever-widening extension of rubber plate successes.

Once it was believed that a satisfactory rubber plate could be made simply by pulling a matrix from any engraving or type form and then, in turn, molding duplicates. Now, fortunately, most converters realize that the quality of a printing job is dependent to a large degree on the rubber plates from which it is produced. The old feeling that "a rubber plate is a rubber plate" has been quietly laid to rest as specialists have revealed the many factors involved in precision plate making.

Improvements in the molding of rubber represent only part of the credit due the plate maker. In the interests of better printing he has had to extend his activities quite logically into the fields of art work preparation and photoengraving.

So varied are modern printing applications that we find it necessary to make more than 50 different kinds of rubber plates. The ink, the press, the surface to be printed, and the copy all have a bearing in determining the construction of plates for any given job. Thus it is essential that the plate maker engage continually in field and laboratory research to insure that his product will enable the converted to achieve the results he and his customers demand.

The compounding of rubber and plastic blends represents the largest single continuing project of Mosstype Corp.'s laboratory. Every sample of natural or synthetic rubber, and blends of both, are subjected to exhaustive tests that determine its physical characteristics, moldability, and solvent resistance. It is checked for hardness before and after curing, thickness, odor, and pressure required to bond with steel, adhesive, or rubber.

Molding qualities are ascertained by practical testing with various kinds of mold subjects. Resistance to solvent is determined by exposing the rubber to seven or more solvents and observing the effects at designated intervals over a two-week period.

The necessity of research by the plate maker is highlighted by the recent experience of a converter charged with the printing of a new type of film. Wisely, he first consulted his ink supplier for a recommendation of an ink to use in printing the unfamiliar surface. Fortunately, he didn't stop with that recommendation, next he came to us and asked that we determine whether either of the two solvents suggested by the ink people would affect the rubber printing plates.

We quickly learned that one of the two solvents had an extremely deleterious effect on all natural and synthetic compounds, while the other, although it would cause excessive swelling in one synthetic, would work perfectly well with another synthetic or natural rubber. Laboratory pretesting in this case resulted in both long plate life and good printing quality.

Because pattern-plate photoengraving and original art work that are perfectly appropriate for reproduction from metal are all wrong for rubber plate printing, insurance of quality results requires a plate maker to handle all the steps preparatory to actual molding of plates.

Photoengraving from which rubber plate matrices will be made are quite different from run-of-mill engravings. When an engraving is made for direct reproduction, consideration only for its unetched surface is sufficient, whereas an engraving that will be used as a master for rubber duplicates requires that its nonprinting subsurface be etched and routed much more deeply and carefully than is the case with engravings intended for direct printing.

The creation of art work likewise must be accompanied by knowledge of the stretch and contraction to which rubber plates are exposed when mounted on a cylinder. Tables and techniques have been worked out to guide the artist in preparing work that will lend itself to rubber-plate printing.

For instance, if the final printing result calls for reproduction of a circle, the artist must actually draw an ellipse calculated to reproduce as a circle when the plate has been applied to the curved surface of the cylinder. Formulas based on type of rubber to be used, size of plate, size of cylinder, etc. enable the artist to engineer his work to compensate within 0.001 of an inch for the expected distortion. Also, if copy contains close, thin lines, the artist must prepare black and whites with more open lines that, in printing, will afford the desired result.

The rapid advancement that has been made to date, and that is continuing, in rubber plate printing points up the specialized nature of the plate maker's work. It is to the converter's best interest to consider the plate maker an important member of his team who should be consulted with confidence in the planning stage of every job.

The manufacture of rubber plates is as technical and painstaking as making printing plates of any other material. In some respects, rubber plate making is even more exacting.

1. For the great variety of types and kinds of rubber plates now in general use, and

2. Because rubber plates must be *molded* accurately. There is no provision for finishing or correcting as in the electrotype plate.

There are two kinds of rubber plates in general use, hand engraved and molded plates. The former is as the name implies, hand engraved on sheets or slabs of rubber or rubber laminated material and is used principally for coarse printing such as cloth sacks, rough bags, corrugated boxes, and tint blocks. Equipment required is a sharp knife.

The molded rubber plate, with which we are here concerned, is a printing plate capable of doing fine letterpress work on almost any stock or printable surface receptive of aniline or oil base ink.

The molded rubber plate is a *duplicate* plate in the same sense that an electrotype or stereotype is a duplicate. We start with original material which may be metal type, properly locked in a chase, zinc, or copper engravings or electrotype patterns. The accuracy of the original material is a determining factor in the final accuracy of the molded rubber plate.

The essential piece of equipment is an accurate and strong, hydraulic press with steam or electrically heated upper and lower platens. It should have a minimum pressure capacity of 1000 p.s.i. on the working area.

The first step in making a molded rubber printing plate is the production of the matrix from the original material. The second is the molding of the rubber from the matrix.

The matrix material is a phenolic matrix sheet, bakelite, or similar. The material is available in sheet form, in a variety

of sizes and kinds, appropriate for the particular kind of rubber plate to be made. It is a thermosetting material which softens on the application of heat and then polymerizes into a solid rigid mass, impervious to heat thereafter.

In production the original metal plate or type form is placed in the press and covered with a sheet of matrix material. The hydraulic press, operated at a temperature of about 300° F., is first closed until a light pressure is established between the matrix and metal pattern. This is done for only a minute or so until the matrix sheet has softened sufficiently to permit it to be squeezed into the pattern. This is done by increasing the pressure gradually until the matrix has been pressed into all the detail of the original. The press is then held in a fixed position for about 10 min. to allow the matrix to polymerize and become permanently hard.

The unvulcanized rubber plate material is available in rolled sheets with a cloth or paper liner on one side and dusted with a powdery lubricant on the other. Most compounds for rubber plate making will cure or vulcanize in 8 to 12 min. at a temperature of about 305° F.

Enough unvulcanized sheet rubber is laid on the matrix to give the desired plate thickness, and then the procedure for molding the rubber is similar to molding the matrix. After the moderate pressure of the preheat period which softens the rubber, a fixed pressure of 300 to 500 p.s.i., for about 10 min., will complete the cure. The thickness of the rubber plate is determined by the use of steel thickness gages or bearers, which are placed between the platens of the press outside the working area. After the cure period, the rubber plate is stripped from the mold, allowed to cool, excess rubber is trimmed away and the plate is then ready for application to the printing press cylinder.

The foregoing is general procedure for the manufacture of plain molded rubber printing plates and such plates are generally mounted to the press cylinder by means of a double coated adhesive tape commonly called stickyback. Most such plates are molded to a total thickness of 0.125 in. including the stickyback. Such plates are subject to a certain amount of shrinkage and therefore on work requiring precise size control and shrinkage control, it is necessary to use special nonshrink matrix material and to mold the rubber in layers or plies incorporating nonshrink fabric. Where the operation permits or requires it, the rubber can be molded together with a metal backing, such as spring brass for use on multigraph machines or rigid brass or aluminum for flat plates on patent base or curved plates on web presses whose cylinders are grooved for electrotypes.

In all cases, consultation with the manufacturer of the unvulcanized rubber or the dealer in rubber plate making supplies is suggested. Most rubber plate problems of a special nature can best be handled by a commercial plate making concern specializing in rubber plates to the trade.

Meeting of December 8

About 65 members and guests were present at the Dec. 8, 1953, meeting of the Metropolitan District, Empire State Section of TAPPI, at Fraunces Tavern in New York City.

Professor Arthur W. Thomas, Professor of Chemistry at Columbia University, spoke on "The Chemistry of Aluminum Sulphate and Related Compounds." Professor Thomas explained certain peculiarities in the properties and the complicated nature of basic aluminum salt solutions by a theory of polymerization known as olation. This theory supplemented by the phenomenon of oxolation is general in nature and provides an explanation for the properties of basic metallic salt solutions, including the colloidal state. Professor Thomas related this work to the paper industry, explaining how the reaction of complex aluminum compounds with rosin affects the sizing of paper, illustrating his talk with a number of slides and demonstrations.

The talk was followed by an interesting discussion period, during which a number of sizing problems were explained on the basis of the aluminum complex. David Lurie of the American Cyanamid Co., who was also scheduled to speak, unfortunately was unable to attend because of illness.

At the next meeting to be held on Jan. 12, 1954, Harris O. Ware of the Hercules Powder Co. will discuss the use of sodium carboxymethylcellulose (CMC) in the paper industry.

L. E. Georgevits, *Publicity Chairman*

Pacific

The Pacific Section of TAPPI met at Longview, Wash., on Nov. 3, 1953, with an attendance of 173. Fred Weleber presided as chairman and Alan H. Vroom of the Weyerhaeuser Development Center presided as moderator for the afternoon technical session.

The technical meeting was held at 2:00 p.m. at the Lower Columbia Junior College and four papers were presented on the general subject, "Products from Wood." They were as follows:

"Research at the Forest Products Laboratory on Veneer, Plywood, and Lumber with Paper Overlays," by R. J. Seidl, H. O. Fleischer, and B. G. Heebink, Forest Products Laboratory, Madison, Wis.

This paper presents a general review of research work conducted at the Forest Products Laboratory on combinations of paper and veneer, plywood, and lumber. The main objective in the use of overlays was to improve utilization of wood by upgrading products or producing products with improved surface characteristics.

In addition to paintability, overlays were evaluated for their abilities to obscure defects in the base wood; increase resistance to abrasion, water, water vapor, and chemicals; reduce dimensional change in lumber veneer; and to increase strength and stiffness of veneers.

Studies were made of the effects of fiber furnish and types and amount of resin on the sheet properties, and how these properties affect the performance of the overlay.

Strong papers applied to veneers resulted in a strong, stiff sheet material that retains a large percentage of its strength at high relative humidities. Favorable properties of overlaid plywood were confirmed by more extensive testing and usage. It appears that lower grade veneers or new species could be used with success. Preliminary testing has shown that large knots and other defects in no. 2 common pine were fairly well obscured, and a marked reduction in the swelling of lumber upon wetting was obtained through the use of a paper overlay.

"By-products of the Redwood Industry," by Robert W. Miller, Pacific Lumber Co., Scotia, Calif.

Redwood trees are unique in both physical and chemical characteristics and the Pacific Coast redwood industry which thrives on their proper harvest is making continually greater progress in the more complete utilization of wood, looking forward to the day when all wood substances not adaptable to lumber products will be converted in by-products plants equipped for mechanical and chemical processes, thus utilizing all the wood resources of the forest.

Tangible evidence of progress in by-product development is the present utilization of the fibrous bark peeled from redwood logs before milling. The bark yields an excellent loose-fill insulation plus finer fiber fractions which find a variety of uses in industrial applications.

Wood waste is also recovered in edge and end gluing operations, Pres-to-Log manufacture and the preparation of wood fiber for use in restoring lost circulation in oil well drilling operations.

Other industries participate in the utilization program through purchase of redwood chips for further processing into pressed boards and into part of the furnish for the manufacture of impregnating felts.

The most recent utilization development involves the recovery of the chemical extractives of redwood bark for broad and diversified industrial use as a deflocculating agent with application to oil-well drilling muds, master batching of rubber latex, and boiler water treatment. Other outlets for this material in various stages of development or use include leather tanning, ore processing, and ceramics. The bark residue from the chemical extraction is utilized as a portion of the furnish for the preparation of a low-density, structural-type insulation board, well adapted for use in cold storage and frozen food locker installations.

"The Adaptability of Western Woods to the Manufacture of Dry-Formed Hardboard," by Ronald G. Frashour, Oregon Forest Products Laboratory.

New means of industrial employment is being sought for some Oregon communities where supplies of saw timber are diminishing. Use of Douglas-fir sawmill residues for hardboard is increasing. Suitable raw materials for this product might also come from secondary species. The manufacture of hardboard by dry-forming offers advantages over wet-forming processes because of lower capital investment, greatly reduced use of water, and lower operating costs.

Because of these factors, the Oregon Forest Products Laboratory has initiated a research unit to investigate the use for dry-formed hardboard of lodgepole pine, Sierra juniper, ponderosa pine, western hemlock, white fir, and red alder.

The study of lodgepole pine has been completed, and the investigations of hemlock and juniper are nearing completion. The work with lodgepole pine showed that an acceptable board can be produced by using fiber from steamed chips, with $2^1/_2\%$ resin binder and $1^1/_2\%$ water repellant (either a rosin size or wax) with acid-controlled conditions.

Results from laboratory work cannot be translated directly in terms of a commercial operation, but the results are encouraging and lodgepole pine appears to be a promising source of raw material for the production of dry-formed hardboard.

"A Wet-Process Hardboard Plant" by G. Eugene Tower, Forest Fiber Products Co., Forest Grove, Ore.

The hardboard industry in the United States has developed rapidly in the past 8 years as shown by the following comparisons:

Hardboard for August, 1953	40,000 tons
Insulating board, August, 1953	85,000 tons

The above gives a ratio of hardboard to soft board tonnage of approximately 1 to 2 while in 1940 the ratio was approximately 1 to 9.

One of the processes for production of hardboard is the wet process. This process has the essential steps of reducing wood chips to fiber by attrition type mechanical means, forming the fiber or pulp from water suspension into a wet sheet, and consolidating and drying the wet sheet under pressure in a steam-heated hydraulic press.

The growth of the industry has been accompanied by an increase in the number of processes for making hardboard. However, the industry is now in a transition period in which relatively more attention is being given to the marketing problems and less time to new processes. Research and development have an important place in this market approach in finding new uses for present products, new products calling for minor changes in basic processes, and new products requiring new processes. In any market approach the utility of the product from a use as well as a cost standpoint should be considered.

Following the technical meeting the group moved to the Monticello Hotel for a social hour and dinner. Charles Goet of Portland State Extension Center, State System of Higher Education, was the after-dinner speaker.

H. B. Petersen, *Secretary-Treasurer*

Lake States

The second meeting of the Lake States Section was held at the Hotel Conway in Appleton, Wis. on November 10, with an attendance of 135. The chairman of the Section, R. J. Seidl, was absent, having traveled to the West Coast to address a meeting. The vice-chairman, L. A. Moss, opened the meeting and introduced L. J. Rys, manager of Klabin Do Parana De Cellulose Industries, Parana, Brazil, who was attending the meeting. Harry F. Lewis was then introduced. He acted as moderator for a panel program with talks by four men who had attended the International Congress of Pure and Applied Chemistry at Stockholm during the past Summer. The speakers were F. E. Brauns, research associate, The Institute of Paper Chemistry, who spoke on the subject of developments in lignin chemistry; Kyle Ward, research associate, The Institute of Paper Chemistry, who discussed developments in cellulose chemistry; Averill J. Wiley, technical director, Sulphite Pulp Manufacturers' Research League, who discussed developments on spent sulphite liquor; and Harry F. Lewis, dean, The Institute of Paper Chemistry, who talked on wood waste utilization and chemicals from wood.

Mr. Ward reviewed the discussions on cellulose chemistry that took place at Stockholm. Frey-Wyssling had attempted to explain differences in diameter of fibrils as measured by the electron microscope and by x-ray measurements. The former gives diameters of 7 to 30 millimicrons for fibrils, the latter diameters of 5 to 10 millimicrons. Frey-Wyssling's explanation for this is that the fibrils have a crystalline core with an outer layer that does not give an x-ray pattern. Ranby states that these differences are likely due to limits of resolution of the instruments.

At the Stockholm meetings there was considerable discussion on weak linkages in cellulose. It is generally believed that the weak links are randomly spaced although Shulz believes that they are regularly spaced. Pacsu believes that weak links occur in native cellulose, whereas nearly everyone else agrees in the possibility of formation of weak links by oxidation. Sharples has found through hydrolysis kinetics that weak links are produced by oxidation and at random.

The discussion at Stockholm on alkali solubility of cellulose was cited. Gierty and Ranby had stated that beta-cellulose contains glucose and gamma-cellulose contains nonglucose hemicelluloses. Vorgensen would not agree with this; he had hydrolyzed and chromatographed beta and gamma-celluloses and found all original sugars in both types of cellulose. A recommendation of a group of German chemists was presented by Bartunek as to replacing the present alpha-cellulose determination by determinations of the solubility in 10 and 18% sodium hydroxide. It was generally agreed that a range of solubilities is better but that a change would create much confusion in industry.

Mr. Wiley stated that his trip to Europe had been sponsored by the Research League and that the purpose of his trip was concerned with search for new ideas and developments applicable to the disposal and utilization of spent sulphite liquor. Mr. Wiley emphasized the large number of workers engaged in exploring this field in Europe. He estimated that there were 500 men engaged in research and another 500 working on commercial developments. At the Waldof Co. in Germany alone there were 30 men working on biological and pharmaceutical products derived from spent sulphite liquor. Research has been in two main fields: (1) utilization of the sugar fraction, included here are alcohol and yeast production and (2) utilization of the lignin fraction. The latter is expected to be of growing importance. On a commercial level new developments include successful evaporators for spent sulphite liquor.

These include the Rosenblad evaporator developed in Sweden, of which there are numerous installations including several in the United States, and the Escher-Wyss newly

developed in Switzerland which will soon be in production. The use of counter pressure evaporation in Europe with as many as seven effects was mentioned.

Mr. Lewis commented on the efforts of the Europeans to obtain values from sulphite spent liquor beyond its value as a fuel. He mentioned specifically the Borregaard Co. at Sarpsborg, Norway, who have made considerable progress in this direction. Among others they have developed the use of spent liquor as a tanning agent and exported about 25,000 tons of liquor solids to England last year for this use.

S. R. Parsons, *Secretary*

The XIIIth International Congress of Pure and Applied Chemistry

F. E. Brauns

As you probably all know, at the XIIIth International Congress of Pure and Applied Chemistry which was held at Stockholm last July and August, there were special group meetings. Of these, group 23 dealt with lignin and pulping and it is my privilege to tell you something about these meetings. They lasted 5 days and were opened by a general lecture by Professor Karl Freudenberg of the University of Heidelberg, who spoke on the constitution of lignin and, particularly, on its formation in the plant. A part of his lecture covered material which he presented here last year at a special meeting of this section of TAPPI. Freudenberg believes that coniferin is the parent substance of lignin—a concept already postulated by Peter Klason over 50 years ago. According to Freudenberg, there exists at the cambium a layer of new cells which consist chiefly of cellulose. These newly formed cell walls are surrounded and partly impregnated by the cambial sap which contains coniferin, a glucoside consisting of glucose and coniferyl alcohol. The cells which are in a state of lignification contain an enzyme which is capable of hydrolyzing the coniferin into glucose and the very unstable coniferyl alcohol. By means of a redoxase or phenoldehydrase the coniferyl alcohol is condensed and partly dehydrogenated, with the formation of lignin. That such enzymes and redoxases actually are present in wood has been proved experimentally by means of indican which is a glucoside of glucose and indoxyl. This indican is hydrolyzed by the same type of enzymes and gives indoxyl which is converted by the redoxases into indigo, as shown by the appearance of a blue color. In the plant, similar reactions take place with coniferin.

Freudenberg has also studied the formation of lignin by experiments synthesizing lignin. During the past 5 years he has carried out experiments in which ordinary coniferyl alcohol, radioactive labeled coniferyl alcohol, and sinapinyl alcohol, which is a coniferyl alcohol with an additional methoxyl group at the carbon atom 5 of the benzene ring, have been subjected to the action of an enzyme isolated from mushrooms. This enzyme does not attack the glucoside but does attack the liberated aglucon. When coniferyl alcohol is treated with such a mushroom enzyme, polymerization products are obtained. These very closely resemble isolate native lignin with respect to chemical composition, and chemical and physical properties. A mixture of coniferyl alcohol and sinapinyl alcohol gives products which resemble hardwood lignin. By using radioactive labeled coniferyl alcohols, Freudenberg was able to show that the formaldehyde which is liberated on distillation of lignin with 28% sulphuric acid originates from the γ-carbon atom of the side chain, and, by the isolation of a radioactive isohemipinic acid, that at least part of the condensation of the coniferyl alcohol takes place between the β-carbon atom of the side chain and the carbon atom five of the benzene ring. By prematurely interrupting the attack of the mushroom enzyme on the coniferyl alcohol, Freudenberg succeeded in isolating a dimer, the dehydrodiconiferyl alcohol, the structure of which would explain the formation of isohemipinic acid on oxidation of methylated lignin.

The first paper on the agenda of the lignin group was by Professor v. Wacek of the Technische Hochschule at Graz, Austria, on "The Methoxyl Content of Sprucewood." As we know, in the lignin determination according to Klason, only 90% of the methoxyl of sprucewood is found in the lignin, the remaining 10% usually being attributed to carbohydrates and being found in the filtrate. Wacek and Schroth believe that the missing methoxyl belongs to a lignin fraction which remains in the holocellulose and cannot be determined as acid lignin. Of this missing methoxyl, only a small part, if any, can be found in the sugars of the hydrolyzate and this part must be attributed to a wood component difficulty soluble. Nor does the lignin from a degummed or prehydrolyzed wood contain the total methoxyl of the wood; a part must be hard to split off. In order to differentiate between the various types of methoxyl groups, Wacek modified the methoxyl determination of Ender and Storch in which the methoxyl groups are split off as methyl alcohol which is then determined by oxidation. With this method, which is much more complicated than the ordinary Zeisel determination—and I saw the apparatus in operation at Graz—Professor Wacek believes that he can selectively saponify the methoxyl groups in lignin and, by comparing it with model substances, can obtain some information on the type of methoxyl in the wood and on the type of methoxyl which is not found in the acid lignin.

This, of course, brought up the old and much-disputed question as to the presence of a lignin-carbohydrate complex in wood. So Professor Traynard of the École Francaise de Papeterie at Grenoble, France, gave the next paper on "The Existence of Carbohydrate Units in the Molecules of Some Extracted Lignins." Lignin was isolated from poplar under mild conditions, with chlorine in carbon tetrachloride at room temperature, and as ethanol lignin. The lignin preparations so obtained were carefully purified from solvents in which carbohydrates are insoluble and were then fractionated by a kind of chromatographic fractionation on aluminum oxide. The acetylated products which were soluble in benzene were similarly fractionated. The fractions so obtained, when subjected to a hydrolysis with boiling *N* sulphuric acid for 1 hr., did not give a trace of sugar in a paper chromatogram. On longer hydrolysis, however, xylose, arabinose, and a hexose were found. In spite of the relatively mild hydrolysis conditions, no polysaccharide was found in the hydrolyzate. Since the lignins did not give any furfurol on distillation with 12% hydrochloric acid they were free of pentosans. The fact that these sugars are so difficult to remove from the lignins, and because they are not in the form of a polysaccharide, suggests that they form a fundamental part of the lignin molecule and are combined with the lignin by an ether linkage. The work presented was carried out by Mr. Ayroud.

"The Question of the Existence of Lignin-Carbohydrate Linkages" was the title of the next paper, presented by H. Richtzenhain of the Swedish Forest Products Research Laboratory at Stockholm. When low-sulphonated wood is extracted with cuprammonium hydroxide the greater part of the lignin and a part of the carbohydrates remain as a residue, with a ratio of lignin to carbohydrates of 1:1. However, when the sulphonated wood is subjected to a mild hydrolysis with dilute acid then considerably more carbohydrates can be extracted with cuprammonium hydroxide; also in the presence of air the greater part of the lignosulphonic acid is dissolved. This lignosulphonic acid, after it has been purified via its quinine salt, has a low copper number which increases considerably after a mild hydrolysis. Also with a methylated wood it is possible to extract the carbohydrates only after a preliminary acid hydrolysis. When the methylated wood is

E. Brauns, Research Associate, The Institute of Paper Chemistry, Appleton, Wis.

extracted with 70% formic acid, only carbohydrates are dissolved and the remaining residue has a lignin to carbohydrate ratio of about 1:1. With a more concentrated formic acid, lignin and carbohydrates go into solution simultaneously, and a lignin with free phenolic hydroxyl groups is obtained. The results of all these experiments are considered to be a confirmation of the presence of a lignin-carbohydrate bond.

The next paper was by Paul Lange, also of the Swedish Forest Products Research Laboratory, on the "Relative Mass Distribution Within the Cell Wall of Spruce and Birch." By x-ray absorption curves it was found that the ratio between the extinction in the secondary wall and in the middle lamella is about 1.40, whereas it should be 1.19 if these layers consist only of carbohydrates and lignin, respectively, and if these were deposited with the same mass density across the fiber wall. This difference is explained on the basis that the mass density in the middle lamella is lower than in the secondary wall and that the middle lamella has a more porous structure which facilitates the penetration of the cooking liquor and thus causes a more rapid attack in the sulphite cook.

"The Lignin Distribution in the Cell Plant Wall Studied by Chemical Treatments" was the title of another paper by Professor Traynard and co-workers. Microtom sections of chestnut, poplar, beech, and sprucewoods which had been delignified with chlorine in carbon tetrachloride, with nitric acid in acetic acid, by oxidation with sulpho-chromic acid at 0°, or by means of hydrotropic solvents, were examined under the microscope. The extractions with chlorine and with nitric acid gave two types of lignin preparations one of which was soluble only in soda solution, the other of which was soluble in soda solution and in alcohol. The microscopic examination of the delignified fibers indicated that those of chestnut and spruce contain one layer, that of poplar two, and that of beech four layers. A part of this work is also in Mr. Ayroud's thesis.

In a paper by Professor F. F. Nord of Fordham University, "On the Structure of Native Lignin and the Mechanism of Lignification" it was shown that enzymatically liberated bagasse lignin contains the guaiacyl. syringyl, and *p*-hydroxyphenylpropane building stones. The latter was also found in the lignin from Scots pine and birch. A mechanism of lignification involving the conversion of carbohydrates into *p*-hydroxyphenylpropane building stones as intermediate in the lignin formation was discussed.

Dr. Kratzl of the University of Vienna in Austria next presented a paper on "Assimilation Experiments with $C^{14}O_2$ and the Synthesis of C^{14} Labeled Coniferin" in which he showed that the radioactive carbon of the carbon dioxide is assimilated by the plant and is found in the carbohydrates and in the lignin. The radioactive coniferin was labeled at the carbon atom two of the side chain.

By "Nitrobenzene Oxidation of Some Lignin Model Compounds" J. C. Pew of the Forest Products Laboratory at Madison showed that guaiacyl-propane derivatives, which have a carbon atom attached to the carbon atom five of the benzene ring, give compounds in which this carbon atom has been oxidized. In all instances, considerable amounts of 5-carboxyvanillin were obtained. Sprucewood, on the other hand, gave only a relatively small amount of carboxyvanillin.

Another paper by Mr. Richtzenhain on the "Decomposition of Lignin and Lignin Model Compounds with Sodium Hypochlorite" showed that at least two reactions take place—a very fast one, followed by a much slower one. Native lignin, hydrochloric acid lignin, ethanol lignin, and lignosulphonic acid consume about 7 to 8 moles of hypochlorite, whereas the thiolignin requires 10 to 11 moles. A study of the ultraviolet absorption curves of the oxidized lignin preparations indicates that benzene rings are opened. A methylated lignin consumes much less hypochlorite. On the basis of these oxidation experiments and of model compounds the constitution of lignin was discussed.

A paper which I unfortunately missed was given by Professor Walter Fuchs of the Technische Hochschule at Aachen. It was entitled "Investigations Concerning Lignin and Wood" and dealt with the action of ketene on sprucewood and Asplund fiber. As we had made similar experiments several years ago without significant results, I was particularly interested in this paper and was sorry to have to miss it. Since ketene reacts almost instantaneously with water, such experiments must be carried out under anhydrous conditions.

The next group of papers dealt with the reactive groups in lignin. "The Phenolic Elements in Lignin" was the title of a paper given by Mrs. Aulin-Erdtman of the Central Laboratory of Cellulose Industry at Stockholm. Mrs. Erdtman found that, when the ultraviolet absorption curves of lignin preparations are taken in an alkaline solution instead of in an indifferent solvent, the maximum of the curve shifts toward the longer wavelength and the change in the extinction caused by ionization is proportional to the concentration of phenolic hydroxyl in the solution. This change was utilized for a quantitative determination of the phenolic groups in lignin after the method had been checked with model compounds of known phenolic group content. The results indicated that the phenol content found by this method agreed in general with that determined by other methods, except that, in isolated native lignin and in Freudenberg's synthetic products, a higher phenolic hydroxyl content was found. The most significant result of this investigation was the finding that no increase in phenolic hydroxyl was detected in the lignin after sulphonation, indicating that no new phenolic hydroxyl groups are liberated during the sulphonation as had been claimed earlier by Freudenberg.

The paper by Mr. Gierer of the Swedish Forest Products Research Laboratory at Stockholm also dealt with "The Phenolic Groups in Lignin." This investigator found that, on treatment of isolated native lignin with quinone monochloroimide, a condensation product was obtained that behaved chromatographically and spectrographically like quinone imide condensation products of other phenolic model compounds.

"Studies on the Reactive Groups of Lignin" was the title of a paper presented by Mr. Adler of the Swedish Forest Products Research Laboratory. Mr. Adler confirmed our earlier findings of the presence of a carbonyl group in isolated native lignin by its reaction with hydroxylamine. When the native lignin was treated with sodium borohydride the carbonyl group was reduced. This reduced lignin reacted with methanol-hydrochloric acid and gave a methanol lignin with a methoxyl content similar to that of the original lignin, which indicated that, in the reaction of lignin with methanol-hydrochloric acid, α-carbinol groups, and not a carbonyl group, are etherified.

The famous A, B, B′, X, and Z groups in the lignin molecule were the subject of two papers, one by Professor Mikawa of Tokyo on "*p*-Hydroxybenzyl Ethers as Lignin Models," the other entitled "A New Model Substance for the B′-Groups in Lignin" by Mr. Lindgren and co-workers of the Swedish Forest Products Research Laboratory. Mr. Mikawa believed that, by sulphonation or sulphidation at pH 7, he had obtained evidence that the X-group in lignin may be a para-hydroxybenzyl alcohol or alkyl ether group. Mr. Lindgren found that, in the sulphonation with neutral sodium sulphite, a wood with a solid so-called "low-sulphonated lignosulphonic acid" is obtained. The latter can be dissolved by heating the wood with dilute acid, whereby the B-groups, which are benzylalkyl ether groups and apparently identical with Mikawa's X-groups, are hydrolyzed to give B′-groups. The dissolved low-sulphonated lignosulphonic acid therefore contains not only sulphonated X- and Z-groups but also B′-groups which can be sulphonated. With substituted benzyl

alkyl ethers, such as β-guaiacyl ether of α-veratrylglycerol, as model substance, it was found that this ether is hydrolyzed and sulphonated at a rate of the same magnitude as that of the sulphonation of the B′-group in lignin.

On Saturday there was a general lignin discussion: chiefly the isolation and the nature of native lignin and the methoxyl content were discussed with Messrs. Jahn, A. Björkman, Freudenberg, v. Wacek, and Kratzl as the principal speakers. The sulphonation of protolignin, hydrochloric acid, and methylated lignin, in which I was particularly interested, was not discussed because of lack of time.

Monday morning was devoted to the utilization of lignin, with Mr. Salvesen as chairman. There were only two papers on the program. The first dealt with "Chemical Reactions in the Lignin Molding" by Mr. Sorgato of the Institute for Industrial Chemistry at Palermo, Italy. The work that he reported had been carried out during the war and dealt with the production of plastic from lignin in order to save scarce phenol. On the basis of an extensive study, it was found that the lignin used should have a high content of phenolic and a low content of aliphatic hydroxyl groups. For this reason he used an alkali lignin which was condensed with aldehydes. Either the plastic was not good or the process was too expensive because the production of such molding powders was discontinued after the war.

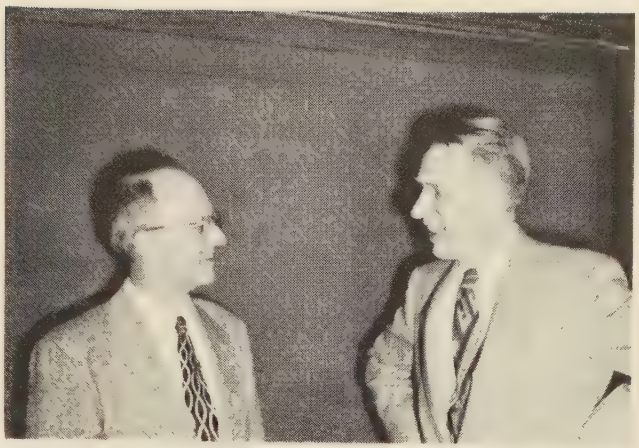
The other paper was by Messrs. Othmer and Ricciardi of the Polytechnic Institute of Brooklyn and was entitled "New Lignin Addition Compounds of Sulphur and Cresol as Bonding for Wallboard from Sawdust." They described experiments on the preparation of molding powders from lignin and cresols at 200 to 260° under pressure and in the presence of small amounts of sulphur. This gave hard, strong, and water-resistant plastics. By the same treatment the lignin in the wood may be changed in such a way that wallboards can be made from sawdust and shavings without the use of additional adhesives. Neither the chemical, the physical, nor x-ray analyses allowed any speculation as to the chemical reaction mechanism involved.

Kalamazoo Valley

The third 1953–54 dinner meeting of the Kalamazoo Valley Section of TAPPI was held Thursday, December 3, at the Hotel Harris, Kalamazoo. About 85 members and guests were present.

Presiding was Chairman R. H. Hurst, Kalamazoo Vegetable Parchment Co., who announced plans for the joint TAPPI-Superintendents Association meeting to be held Jan. 4, 1954, at the Hotel Harris.

W. F. Hathaway, Kalamazoo Vegetable Parchment Co.; W. A. van den Akker, The Institute of Paper Chemistry; R. H. Hurst, Kalamazoo Vegetable Parchment Co.; R. T. Elias, Western Michigan College; and R. T. Trelfa, Watervliet Paper Co.



J. A. van den Akker, The Institute of Paper Chemistry and R. T. Elias, Western Michigan College

Treasurer R. T. Elias, Western Michigan College, announced that paid membership of the section—to date—was 176.

Vice-chairman James A. Dean, Michigan Paper Co., introduced J. A. Van den Akker, head of the physics group of The Institute of Paper Chemistry who presented a talk on "The Significance of Paper Tests." The talk was followed by an interesting and lively discussion period. Mr. Van den Akker's talk concerned the basic relationships of paper tests to fundamental properties of paper.

Tensile strength measurements are among the fundamental evaluations of the basic properties of the paper web. Taken in different ways, different properties are measured. One can obtain load-elongation curves, modulus of elasticity, ultimate tensile strength, and ultimate tensile strain.

Bursting strength is approximately proportional to the product of average tensile (average of cross machine and machine direction) and the square root of the ultimate breaking strain in the machine direction, providing correction is made for the pressure required to distend the rubber diaphragm itself. This correction is significant for lightweight papers, being in the neighborhood of 3 to 5 p.s.i. Further details are given in The Institute of Paper Chemistry Research Bulletin (Vol. 4, No. 3) under the title, "The Meaning of the Bursting Strength Test."

The theory of the tear test is qualitative rather than quantitative, but has been developed to aid one's thinking. The theory deals with the way in which energy is dissipated during tearing. Details have been given in Instrumentation Studies XLVI, *Paper Trade J.* 118, No. 5: 13–19 (Feb. 3, 1944). It requires less energy to break a fiber than to pull it from the paper mesh; therefore, as pulp is beaten and more bonding developed, the ratio of fiber break to fiber pull increases and tearing strength decreases. Likewise, in general, when bonding agents are used, the tearing strength is often adversely affected.

Stiffness is a measure of structural rigidity and is thus influenced by over-all structure and dimensions. It cannot be readily related to fundamental properties of the fiber structure itself. Most stiffness tests have more than one source of stress and therefore do not give true stiffness values. A true stiffness can be determined by considering a strip of paper or board as a cantilever and measuring deflection under its own weight. It is necessary to run deflection two ways to compensate for roll curvature.

Folding endurance tests are very useful, but difficult to interpret. The test may measure different properties of heavy and light papers. Loading and angle and curvature of bend are highly arbitrary, but the test nevertheless yields fatigue data not obtainable from other data.

Objections to commonly used pendulum testers have been frequently voiced. However, the errors caused by changes in

rate of strain are not generally significant for paper testing and the pendulum type can be considered very useful for tensile testing although unsatisfactory for strain measurement.

Load-elongation curves have opened a new field of measurement which relates to fundamental properties of paper. Shape of the curve, ultimate strain, ultimate tensile, and area under the curve have proved important in several use requirements.

Work by Steenberg, Rance, and others was carried out at a very low rate of straining, and the work suggested that rate of straining was very important. Later work has indicated that pulse transmission of stress through the paper strip can explain some of the difficulties met when very high straining rates were attempted. Mr. Van den Akker performed simplified derivations of many of the relationships of properties measured in paper testing. Of particular interest was his explanation of pulse formation and transmission and its relationship to the rate of straining of the specimen. Critical straining rate (where specimen breaks before stress has reached the fixed end of the paper specimen) can be calculated by combining components of modulus of elasticity and ultimate strain of paper under impact conditions.

Creep and relaxation studies are also useful for some properties.

R. T. Trelfa, *Secretary*

New England

Registration took place at 3:30 p.m., Oct. 9, 1953. Two papers were presented at the technical session held from 4 to 6:15 p.m.

The first paper was titled "The History of Stream Improvement in Connecticut and Massachusetts" and was presented by Russell L. Winget, executive secretary, National Council for Stream Improvement. The active discussion which followed was moderated by Mr. Winget, assisted by Harry Gehm, technical adviser, National Council for Stream Improvement.

The second paper of the afternoon was given by Joseph Theriault, Technical Dept., Robert Gair Co., Inc., Uncasville, Conn. Mr. Theriault's paper was entitled "How Statistics Can Be Used to Control Quality in Papermaking." Mr. Theriault answered many varied questions regarding his paper as well as statistical problems in general.

Following the banquet, the following movies were shown:

"From the Mines to the Finished Product," Courtesy of Wisconsin wire Works.
"Green Gold," Courtesy of Union Bag & Paper Corp.
"Lures of the Berkshires," Courtesy of The Berkshire Inn.

Those members who remained until Saturday were given an opportunity to visit the Rising Paper Co. in Housatonic, Mass., in the morning, and in the afternoon, a golf tournament was held.

Mr. Winget commented on the fundamental facts involved in stream pollution in New England with particular reference to Massachusetts and Connecticut. His talk dealt specifically with the legislation and regulations in the New England States relating to stream pollution control, the treatment required for paper mill waste by the New England regulatory agencies and the outlook for future treatment requirements for paper mills in the area.

He stated the purposes of the National Council for Stream Improvement of the pulp and paper industry, which was organized in 1944, were to conduct research relating to pulp and paper industry waste disposal problems and to furnish engineering assistance to the industry in meeting these problems.

Speaking of legislation, Mr. Winget stated that during the past 10 years, all except three or four of the 40 pulp and papermaking states in the country had enacted special legislation dealing with stream pollution. He reviewed the specific regulations which applied to the states of Massachusetts and Connecticut and compared them with regulations applying in other New England states.

Mr. Winget discussed the various pulp and paper industry pollution problems in Massachusetts and Connecticut. The most common pollution problem in this area is that of solids removal for which equipment and techniques are readily available, although in some cases sludge dewatering and removal problems present difficulties. Other problems more difficult of solution are the problems of B.O.D. reduction and color removal in rag and flax cooking and other pulping liquors.

Mr. Winget presented general information regarding the cost of pollution abatement installations. Solids removal installations for a typical 100-ton mill require an expenditure from $250 to $500 per ton of product. In B.O.D. reduction installations, where practical processes have been developed, an expenditure of from $2000 to $5000 per ton of product is required. By far the most difficult problem is that of B.O.D. reduction since there is no universally practicable and economic method for accomplishing significant reductions in the B.O.D. of pulp and paper mill wastes. Mr. Winget stressed the necessity of all mills giving serious consideration to stream pollution problems so that they can assemble information which will be needed to indicate future treatment requirements. He stated that such mills should start immediately to accumulate data relative to the nature of their wastes and the conditions of the receiving waters. These data should include: (1) a mill survey to determine the following: (a) total volume of waste, (b) suspended solids, (c) B.O.D., (d) color, and (e) pH; (2) a river survey conducted above and below the mill outfall at both high and low water to determine: (a) stream flow characteristics, (b) dissolved oxygen, (c) suspended solids, (d) color, (e) pH, and (f) turbidity together with physical observations such as sludge tanks, floating solids, wastes from other industries, oil, etc.

The National Council, through its direct mill service facilities, is organized to render technical assistance to member mills in organizing mills and receiving stream surveys and also in general assisting member mills in local pollution problems. This service is provided to member mills entirely without charge.

R. W. Ramsdell, *Secretary*

Chicago

The Chicago Section of the Technical Association of the Pulp and Paper Industry at its November 16 meeting held at the Chicago Bar Association, Chicago, featured a panel discussion on adhesives. Ed Berg, Ace Carton Corp., chairman of the Section, presided at the meeting at which three specialists discussed various types of adhesives including resin, latex, dextrine, and animal glue. Speakers were Robert Pett, National Starch Products, Inc., Edward Higbee, consultant, and C. S. Young, Swift and Co.

Resin adhesives were discussed by Robert Pett, National Starch Products, Inc., who stated that most of the resin adhesives used in the packaging and converting field are based on polyvinyl acetate. The emulsion form is most important to the paperboard and paper field, and is characterized by ease of handling and high speed of set; it is easily modified with solvents, plasticizers, extenders, and other materials to meet a variety of requirements. Use of these modifiers may result in increased speed, better water resistance, and greater specific adhesion to difficult surfaces.

While polyvinyl acetate itself has only fair water resistance requiring formulation with other resins to obtain a high degree of water resistance, recent developments have made possible highly water resistant polyvinyl acetate emulsions for use in adhesives. Another recent development is the freeze-thaw stable emulsion. Normally, emulsions will break, become

Edward Higbee, consultant; Robert Pett, National Starch Products, Inc.; Edward Berg, Ace Carton Co.; and C. S. Young, Swift & Co.

heavy and gummy, and are unusable when frozen. Today, however, it is possible to obtain resin emulsion adhesives that may be frozen but which will thaw out and return to normal viscosity and working properties. Uses of resin adhesives in package sealing, laminating, greaseproof coating, etc. were outlined.

The second speaker on the panel was Edward Higbee, who discussed the use of latices in adhesives. He outlined the characteristics of natural latex, Neoprene, GRS, styrene, and the polyvinyl chloride. He outlined the characteristics and uses of these materials in adhesives.

Final speaker on the program was C. S. Young, Swift and Co., who described the fundamentals of animal glues and dextrines. He presented a schematic diagram of the basic types of dextrines and showed that addition of various materials, such as water, borax, soda ash, phosphate, and acid, formed adhesives with different characteristics. In similar manner, he showed how various modifying agents added to liquid glue, flexible glue, and dry glue would give a great number of combinations to provide adhesives that could meet many requirements. In concluding his discussion, Mr. Young stated that he had worked with animal glues for some 20 years and that their applications were increasing constantly, with new uses being found as various types of adhesion problems were presented in the packaging industry.

Allergies to Be Features of January Meeting

At the Jan. 18, 1954, meeting of the Chicago Section of TAPPI, T. G. Randolph will discuss the relationship of food allergies to paperboard and paper containers. The meeting will be held at the Chicago Bar Association, 29 S. LaSalle St., Chicago, Ill.

Corn and wheat products (starch) are leading causes of food allergies and many people must completely eliminate such foods from their diets. People with such allergies might pick up enough starch from foods packaged in paper or paperboard to give them trouble. For instance, milk contained in paperboard cartons has been known to pick up enough starch to cause corn-allergic persons to have asthma, whereas the same people suffer no ill effect from drinking milk contained in glass bottles. Other liquid foods, or foods with a liquid phase such as cheese, can also pick up enough starch from paper, paperboard, or cellophane packages, to cause allergy troubles. In packaging cheese in cellophane, for instance, the cellophane may be treated with starch to make the cheese slide into the package readily. This amount of starch is sufficient to cause trouble to persons with a corn or wheat allergy.

Mr. Randolph is a specialist inalle rgies. He was formerly in charge of the Allergy Clinic at the University of Michigan, but for the past 10 years he has practiced in the Chicago area specializing in this field. He has co-authored a book on food allergies and has written a number of scientific papers on the subject.

RICHARD W. PORTER, *Publicity Committee*

Delaware Valley

The Delaware Valley Section met at the Engineers Club, Philadelphia, Pa. P. E. Nethercut, treasurer, made the annual report covering the 1952–53 fiscal year. The Auditing Committee of John Diefenderfer (Hercules Powder Co.), T. Morse (Hercules Powder Co.) and Howard Street (National Vulcanized Fiber Corp.) also reported. A discussion of these reports followed.

The Section was reminded again of the Section News letter sent out with each meeting notice.

The meeting was turned over to Emil Padavic (Container Corp. of America), program chairman, who introduced H. O. Teeple (International Nickel Co.).

Mr. Teeple told something of the background behind the making of the movie, "Corrosion in Action," as introduction to the subject of the evening.

"Corrosion in Action" demonstrates leading causes of corrosion, gives the underlining fundamentals in readily understood form, and shows examples.

After the picture Mr. Teeple was questioned from the floor on the subject of corrosion.

Q. A pulp handling system apparently caused brightness changes in the pulp handled which were different in degree at different seasons of the year. Would carbon steel in contact with the pulp be contributing to this change?

A. It is not probable that it would cause such a change but it might be possible. It is not likely that the small temperature change noted would cause appreciable differences resulting in the brightness change rate differences. It is possible the seasonal ambient temperatures of the water would be an important factor.

Q. Which materials would be recommended for hypochlorite bleach systems?

A. Hastalloy C rather than chrome bearing irons. However, type 316 stainless steel is suitable if contact with the bleach is intermittent.

Q. What about materials for handling alum solution; is ceramic lined carbon steel suitable?

A. In handling cold liquid alum, type 316 stainless should do a fairly good job. Durimet 20, or its equivalent, would be suitable for pump and valves. Plastic materials are finding considerable applications in recent years.

Q. What are the recommended materials for fittings as spigots in handling concentrated ammonium hydroxide?

A. Suitable alloys for handling aqueous ammonia solutions are those containing appreciable quantities of chromium, such as austenitic or ferritic stainless steels.

Q. How about vanadium pentoxide corrosion in high temperature superheaters?

A. Vanadium penotoxide corrosion is associated with the use of bunker C fuel oil which in addition to containing substantial vanadium also contains sodium chloride and sulphur. When this oil is burned, the combination of these three contaminants produces an ash or a slag which acts as a flux removing the protective oxide scale. The high nickel alloys, such as Inconel, would be resistant to the conditions if sulphur were not present. The high chromium, lower nickel alloys, such as type 310 or type 309, would be resistant to the conditions if the vanadium and sodium salts were not present. Molybdenum containing alloys are more susceptible to attack under these conditions than those not concontaining molybdenum. The answer to this bothersome problem is the removal of the sodium from the oil.

Lake Erie

Following are the two papers presented at the November 20 meeting of the Lake Erie Section which was devoted to the subject of corrugated quality.

What the Consumer Expects of the Box Manufacturer

Earl B. Candell

When Mr. Lewis called inviting me to speak before your group, I was taken back because I couldn't understand how I could add anything to your knowledge of your product. Certainly you men in TAPPI have an outstanding array of talented people. I always read with great interest *Tappi* which, I understand, publishes the articles and talks presented by your members. It is quite impressive to see the thoroughness with which you are developing the science of paper and board manufacture. I have learned a great deal through this publication.

There are two organizations which seem to be the backbone in establishing good practices and standards in board and container manufacture—these are the D 10 Committee of ASTM and TAPPI. The leadership of these two groups plus the willingness of the industry to voluntarily follow the procedures which they outline is most commendable. This is another example of the American way of doing business.

As I was saying, I was reluctant to appear before you until I was told that my subject was to state what the consumer or purchaser of your product expected of you. Surely no consumer should hesitate in stating just what he wants. That is the least he can do, whether he gets what he wants is up to you. Should he be unreasonable and unrealistic in his requests, then the vendor must set him straight.

Then my next problem was to figure out just what the consumer really did want. It's fairly easy to speak in generalities, most anyone can do that and having said it, everyone agrees because it is so general everyone knows it and has no quarrel. For instance, I could summarize all that I have to say here in these few words—the customer wants what he wants when he wants it. Now I'm assuming that he has known enough about what he wants to have ordered it correctly. Certainly it is most unreasonable for him to assume that you know what is in his mind and thus excuse him from knowing anything about how to set down in order form or specification what he wants.

So, with this assumption, I might reword the statement and say—the customer wants what he ordered when he wants it. And here again I presume that none of you would seriously dispute that this is unreasonable.

Now let's break this down some more. Let's take the second part first "when he wants it." As men in business, you all recognize the importance of proper delivery schedules. In your business you must schedule your raw materials to match up with the order you are manufacturing, and so it is with your customers. Production schedules are laid out and raw materials are scheduled to arrive so as to have minimum inventories consistent with good operations. It is probably the rule today (I know it is in our business) that most plant capacities are severely taxed so that the amount of space given over to stocks of raw materials has been reduced. This calls for closer scheduling. Much of the scheduling is based on promise of deliveries and faith in the supplier to keep his promise.

The orders are placed with a delivery date specified. Acceptance of the order by the vendor is likewise acceptance of the delivery schedule. The time to talk about delivery schedules is *before* the order has been accepted.

And while on this subject of inventories, the consumer assumes that his stocks are all of good quality. Better not to have the stocks at all than to have them only to find that after production has been started they cannot be used.

This item of "when he wants it" must be obvious to you all so I'll not spend any more time on it, though I will talk more about quality.

Now for item (a) "what he ordered."

Earl B. Candell, Head, Package Design and Materials Handling Section, Lamp Div., General Electric Co., Cleveland, Ohio.

Let's assume that he ordered a corrugated box, since that is the item in which most of you are interested. When he ordered it he ordered a certain size. Since most of our boxes are engineered boxes he really does want that size box. By engineered, I mean that they are designed to hold a specific product, there may be inner pieces such as die-cut pads, partitions, etc. that must all fit together. Plus or minus 1/8 in. can often cause trouble when packing. And the type of scores can affect the internal fit. I believe you have had some discussions in you organization about proper scoring.

Size of the box is also important to the customer who uses machine case sealers. Here variation in width and height in boxes can cause a lot of trouble. If the machine is set for the widest box, then the flaps won't meet well for the narrower box, and conversely, if the machine is set for the narrower box, the flaps will overlap for the wider box. Also, too much pressure can be exerted by the side rails and the box pulled out of square. So box size is important.

Material was specified—most specifications will state what kind of liner is desired, less frequently the exact corrugating medium. Usually a range of material is given. To some consumers, the type of material is not too important, to others it is very important. In our case we are quite specific and we really want what we specify. By that I mean we want fourdrinier kraft and no cylinder kraft or jute when it is itemized on our specification as fourdrinier. Each of these materials is good and has a proper use, but when we order one type, we don't want others substituted. There is a reason for this. For one thing—weight. Ours is a lightweight, fairly bulky item—many thousands of packages are used. In shipping, we don't weigh every package, but operate on average weights. Check weights are made periodically for the various package sizes and these weights are used by our traffic and billing departments. If they are to be accurate, then we must be uniform in the type of material we use.

Another factor is that of automatic case sealing. Different materials and finishes react differently with the same glue. These packages go through these machines at a pretty fast rate of speed so that adjustments cannot be made for variations in box materials. Therefore, when we put out a spec for a specific material we expect each vendor who supplies it to use the same type of material, not something "just as good."

In addition to listing the type or kind of material, we list basis weight rather than caliper of stock. We believe that this is a closer way of approaching the board quality than by using merely caliper. While we can't measure the basis weight of the individual sheets very well, we can weigh the combined board and from that appraise pretty well what we are getting.

Strength—this may be specified in several ways. First, there is the bursting strength test required by the Consolidated Freight Classification. We have no alternative but to specify this. Even though we are using an exception package, the burst test will be shown in the spec. There are two other values which are coming into more general use, one the puncture test of the board and the other the compression strength. In our own use, we are putting greater dependence on these two factors and in most instances list the values expected on the specification.

These two factors—puncture test and compression—are very important and to our way of thinking define what we want better than anything we can tell the vendor. A box to store and carry a product safely must be able to withstand certain compression loads and resist puncture from sharp objects. By experience from observation and calculations we know what we need and can get from a first-class operator. In our specifications we list minimum values below which the average of a sample of five boxes should not fall.

Failure to meet these values is objectionable and makes the lot subject to rejection. It is our belief that the box quality

can be largely expressed by a comparison of these three factors—basis weight, puncture resistance, and compression strength.

There are two other things appearing in the specifications—printing and manufacturer's joint—both of which can affect the performance as well as the appearance of the box.

Most people are taking advantage of those big areas on the box to advertise both their product and their name. One of the first things our customers see is the outside of the shipping case—a poorly printed case is very obvious and does not speak for quality. If we are sloppy and indifferent in the appearance of our shipping cases, the inference can be made that we are also poor in the quality control of our own product. Appearance is a very important thing.

This carries over to the color control of the printing. Many companies have certain color standards which they work to and our customers frequently associate the color to the company. So uniformity of color is important. This is particularly true when boxes made by different vendors meet on our customer's stock. Here again, uniformity of color bespeaks uniformity of product.

We also are concerned with how that printing is applied because we know that too heavy an impression will break down the corrugations and give poor compression strength to the box or in other words will jeopardize the stacking strength of the box.

Materials used for manufacturer's joints are usually quite satisfactory. There was a time when we would accept nothing but cloth tape, but these other materials have been improved so that we now accept most any which will not break under the compression test of the box or during the drop tests of the packed container. The greatest trouble we had was with sisal tape which was too stiff or poorly applied. We received many boxes which broke apart at the manufacturer's joint when our operators opened the cases for packing. I have not heard of a complaint like this in a long time, so it is evident that this material has been improved.

While on the subject of printing, I would like to refer to two things, first the importance of following the printing layout as it is given on the specification. Care and thought were given in preparing the printing specifications and they should be followed. Changes in layout by the vendor cause confusion to our operators. They are creatures of habit and look to certain places for the identifying number and also the space for pasting the address and contents tickets. Changes in these locations slow them in their work.

The second is the manner of showing the date of manufacture of the box. I wonder why there can't be uniformity among box makers in how this date is shown. There are years to count, letters to figure out, numbers in various arrangements, and even no dating at all. This date is important to the purchaser for two reasons—inventory turnover and a means of identifying a specific lot should there be any difficulty which needs further checking.

What is wrong with just a simple figure for the month and one for the year, the two separated by a dash, these placed adjacent to the box maker's certificate? You could make our job just a little easier if this simple thing could be done.

And the last item shown on the specification is the manner in which the boxes are to be delivered to the purchaser. The number of boxes to be bundled or tied together is given. Deviation from this causes confusion in stock keeping and inventory control. Sometimes pallet loads are requested.

There are possibly other things which certain users need to put on their box specifications such as flat crush which to some is a very important thing, but I believe I have listed the principal ones.

Before I leave this subject of specifications, I would like to raise a question, since I am addressing a box maker's group. Why can't there be a uniform code developed for specifying the materials which go into making a box? To write out finish, basis weight, and caliper is quite cumbersome and time-consuming. This must be true; otherwise coding would not be used so generally. But why can't this code be common for everyone? Some people use numbers, some letters, some numbers and letters, we at General Electric even have more than one code system in use. Why? We are all talking about the same materials; otherwise we couldn't let you know what we want. Why can't there be standardization in the paper business on such a fundamental thing? Other trades have long since recognized the importance of standard specifications. I realize that many of these pet systems have been in use for a long time, but does that mean that we have to have them forever? I would think that your TAPPI organization would be an ideal medium to work out this standardization and I'll venture to say that there would be no trouble in getting ASTM to go along with it. Maybe the two through such places as the Forest Products Laboratory could work it out together. Our SIPMHE group would be another means of getting together on this. I know that this is not a fundamental thing necessary to the advancement of the boxboard industry, but it would be helpful in establishing it on a more scientific level and would eliminate some confusion which exists today.

And while asking questions, I would like to raise one more and this hits right at quality. What degree of control is reasonable and practical in establishing the burst test, puncture test, and compression test? By that I mean, how much variation from an average should be considered good for these tests or in other words, at which degree of spread or range is the process considered to be out of control? We have run across some terrific spreads in our testing of materials, or at least they seem like terrific spreads to us. Based on any standards of operation of ours, the product is definitely out of control.

I mentioned our testing—you might be interested to know why and how we test boxes.

As you probably know, we have been large users of corrugated boxes for many years, and we have had a package design and specification section for years. I cannot say for sure, but I would guess that our activity is about as old as any company in the country. And until just recently, we bought our packing materials entirely on faith that our vendors did give us just exactly what we specified. But our purchases grew into some very large figures. Nowhere else in our operations did we purchase such large dollar values without checking to approve the quality and uniformity of the product. Not even in our own operations where one of our plants makes and sells to another of our plants would we accept such quantities without check-inspecting them. So it was just logical and good business that we should check packing material.

Another reason for setting up our testing lab was to determine just how we could specify puncture test and compression strength for each individual box size. As I said before, we felt that these two values were fundamental in defining what we expected for the box.

There were various figures published by some laboratories which gave values for compression in terms of perimeter inch and for variously proportioned boxes. These we used as a guide but decided that before any actual figures were given by us, we should have a background of tests which would prove that such values were reasonable.

The first thing we did was to build an air-conditioned test room. In this, the material to be tested was first conditioned so as to reach a stable value of 73°F. and 50% R.H. Sampling was set up to evaluate typical boxes purchased from a number of vendors. A sampling schedule was developed and certain of our factories instructed to send in six samples scattered throughout the shipment of each lot of boxes. Since most of these boxes are ordered monthly, this meant that we would receive monthly samplings. The program was

started in March, 1951, and to date we have made over 430 routine tests.

It was not long before we found that there was a great amount of fluctuation in these samples—fluctuations in the sample lot, between lots of a specific vendor, and between vendors supplying on the identical specifications. It is from these tests that we raised the question of—how much variation must we expect?

Before discussing some of these tests, let me say that all test results are confidential. Since we do use these in discussing quality with our vendors, we will give him the results of our findings on his box only.

We gathered data for well over a year before we started to make any comparative analysis or set up normals. Using the statistical analysis method, we first made a monthly consolidation of the test results for each vendor for the 140-lb. MT and 200-lb. MT boxes. The sigma variation for compression and puncture was computed and curves drawn by the vendor for each. Time does not permit me to go into the details of the development of these curves, nor a discussion of how sigma values are computed.

Let's first consider the compression readings for a composite picture. On the curve there are five horizontal lines. The middle line is the average, the first line above and below is the 2 sigma variation, while the second line above and below is the 3 sigma variation from the center.

We expect that the average of any lot shall not fall below the −3 sigma line and to be in control according to a statistical appraisal of the test results the averages should fall between the −3 sigma and +3 sigma lines.

According to the statistical method of analysis, 68.3% of all tests should fall between the 1 sigma lines, 95.5% of all tests between the 2 sigma lines, and 99.7% between the 3 sigma lines. Now let's consider some curves, first in total, then by vendor. Based on the sum of all tests, our values for the average line don't look to be too far off. The weighted average falls pretty well in line so from that we contend that our expected values as shown on our specifications are not bad.

But now let's see how individual vendors show up. Take the green line; until this Fall, all but a very few points fall between the 3 sigma limits. There was one point in February, 1953, that was very high and seven of the last eight tests have been high.

The red curve has likewise stayed pretty well within the limits, though a little more erratic than the green.

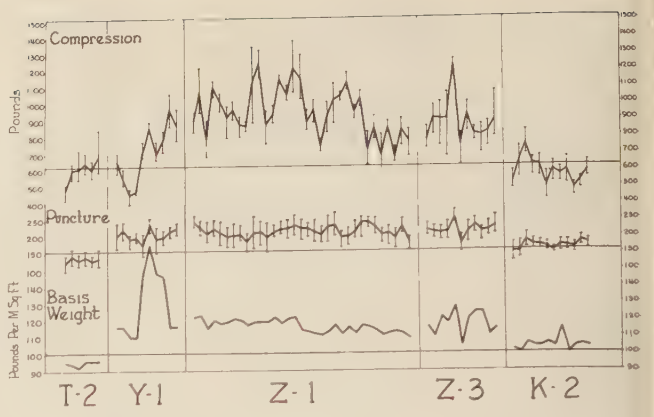
Now look at the blue—here is a vendor that is all over the sheet but mostly on the low side.

Then look at this black curve—practically all values are well above the +3 sigma line. Not only that but the variations are the most extreme on the sheet.

Remember, all of these vendors are working to the same specifications, as far as we know. After seeing these extreme variations our natural question is—why so much variation? Would you say that the vendor having such great variations is as good an operator as the one with less variations? Would you say his production is in control? Just how great a deviation is considered good practice? Frankly, we don't know your business, but from our viewpoint such extremes are not good. The same condition exists in regard to puncture, values. Here it appears that our average and 3 sigma lines are set too conservatively for the bulk of the readings are above the average and for a number of months were above the +3 sigma line.

Here again the green curve is in most instances between the black and the blue, though in the later months, the blue and green curves are fairly close together. The black continues to show high above all others but the amount of variation is not quite as great as for the compression curve. I repeat—why such variations and what should be considered good operation?

In case these composite curves are a little confusing—and I wouldn't be a bit surprised because I must confess they have



been to me, we can look at a specific box type. These composite curves were evolved by the boys who are making these box tests with the aid of our statistical analysis section. The same principles have been used here as are used for evaluating the quality control which our factories show in the manufacture of lamps. When I say that, I don't mean that the limits of variation or sigma values are the same, but the method of computation (using box test values) is the same.

The figure shows actual values for compression, puncture, and basis weight for one specific box size. The tests of each vendor are kept together. The three values for a specific test lot are recorded on the same vertical line. In the case of compression and puncture, the highest, lowest, and average of the five-box sample lot test is shown with the averages forming the curve.

I think this figure is very interesting for it shows a number of things. Let's first look at the comparison by vendor. These fellows are all given the same specification, yet see the variation between vendors of basis weight. And the level of the average puncture corresponds fairly well to the variation of basis weight.

Looking at the compression curve this relationship to basis weight is not as evident.

See the variation between vendor. Then look at the variation between sample lots within the vendor. Notice that the vendor giving the highest readings has the greatest variation—he can make awfully good boxes but is not very consistent. Both the variation of average and of spread or range of sample test are, we think, too great and hence show poor control.

Our statement to this vendor is that he is giving us a higher compression strength than is required to meet our standards, possibly because he is using more material—basis weight. A reduction in basis weight should bring his compression strength down to our requirements, and this reduction of basis weight should mean less board or stock weight and hence a reduction in price.

In other words, if our standards are set properly to give us the protection we expect, then there is no need to buy more.

What I have said here applies to this vendor up until the last seven tests. Here for some reason with little change in basis weight and puncture, his compression strength has dropped—why?

There is still another interesting point brought out on this chart. You will notice that vendor Y1 has some extreme variations in basis weight. The high values are due to his supplying jute instead of kraft. You see why we desire kraft—neither the puncture nor the compression increased in relation to the increased weight. The increased weight cost us more money in the form of increased transportation costs—weight per thousand square feet was about 50% greater.

Another interesting point is that of vendor T2. This fellow is not giving us as much basis weight as we expect, yet his compression is nearly right. Were he to increase his board weight to our standards, he probably would show just

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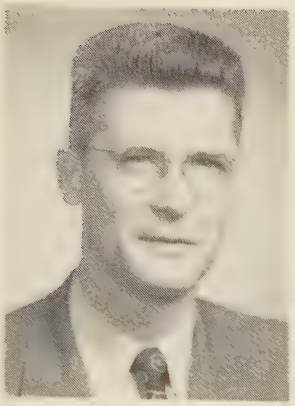

G. C. Lecky, F. J. Kress Box Co.

s good puncture and compression as the better vendors but n this chart he doesn't look good.

We do not claim to be authorities in this subject—there are many people who make this activity their means of livelihood. We got into the work because we are charged with checking nd protecting our quality. Setting up a specification is no guarantee to my employers that we are getting what we say e should have. Nothing would please us better than to find hat this is an unnecessary activity. We still would maintain our laboratory because through it we can determine what e do want.

So getting back to my original subject—what does the customer expect of the vendor? We expect uniformity of erformance for a given specification both between vendors nd between lots of an individual vendor. It looks to us as nough this quality control could be improved.

In closing may I compliment the box industry on the work is doing. The cooperation that is shown generally, the ervice that is rendered, and the interest in progress are truly ommendable. It is a pleasure to work with the various ompanies and I value and enjoy the many fine personal quaintances we have made.

Corrugated Quality

George C. Lecky

The only real interest a user of corrugated containers has in our quality is the quality of the product he receives. Therefore, if we inspect our finished product 100% and only find out that which meets the specifications, we should give him what he wants. However, this plan has several bad features about it—first, 100% inspection is rarely ever more than 60% efficient; second, it would be very costly; and last but most important, it would not help our quality. Quality cannot be inspected into a product; it must be built into it. If we are to assure ourselves of a high quality product, we must make certain that only the best raw materials are used and that every step in its production is controlled at a high quality level.

In order to accomplish this mission of assuring the customer a high quality product, we at Kress have set up a quality control program which is essentially divided into two parts. The first part is accomplished by the quality control laboratory and consists of the following:

1. Setting up specifications and performance standards of raw material.
2. Checking samples of material to see if these standards are met.
3. Setting up quality standards of the finished product.
4. Spot checking the finished product to see if quality standards are being met in our production.

The second part is accomplished at the plant level by means of a rating system which I will explain in detail later.

The quality control laboratory receives samples of the raw materials used. The largest single item of raw material we purchase is paper and most of our laboratory time devoted to incoming raw material is spent on testing the paper. Square foot samples from each roll manufactured for us are mailed to the quality control department at the time the paper is shipped. Our laboratory runs caliper, bursting strength, pH and scuff tests on this paper, determines the basis weight, and examines it for printability and surface appearance.

The bursting strength test is the most important test made on the paper. Standard procedure has been to take six punctures on each sample, three from each side. If we could assure ourselves of the mills' compliance with this specification without making all these tests, we could have more time to spend on improving our own product. An examination of the subject showed the following:

1. The paper mills make these tests on the rolls as they are being run and we are only duplicating their results. Also, this particular test has so much variation that the result obtained from a square foot sample is not a true indication of the condition of the roll.
2. The responsibility for maintaining this test is that of the paper mill and we are only interested in whether or not the mill is maintaining its control.
3. Just as accurate a check can be made with much less expenditure of time by sampling a small portion of the total.

Therefore, we decided to sample only five randomly chosen samples from each car. We run two burst tests (one each way) on each sheet, and plot the averages and ranges of samples of ten on a chart. We have computed what the lower limit for these averages must be to make sure our board is meeting the required bursting strength specifications. When any average goes under this lower limit we contact the supplier to see why the paper does not meet the specifications. We also send copies of our tests to the supplier as a check on our test results. The plant also makes a record of each roll of paper run at the corrugator, and on this record the corrugator operator indicates any defective rolls, as well as the nature of the defects. This enables us to spot running difficulties as soon as they develop and gives the supplier accurate data as to just what is wrong and which particular rolls caused the trouble.

On other raw materials we make periodic checks (such as color of ink and Elmendorf tests on tape), but mainly we rely on reports of plant performance as a check on the quality of those materials.

The laboratory also receives from each plant samples of their finished production which are tested and rated for quality. Results of the tests are sent back to the plants and are consolidated monthly in a report which shows how each of the plants rank qualitywise.

In the plant we maintain our quality standards by means of a sampling and rating system. Rating corrugated quality by a sampling method is actually a very simple process. At regular intervals a sample should be picked up from each machine on which a check is to be made. The only important feature in this is to be sure that no selection of the sample is made. The inspector merely picks up any piece without making a choice between one and another, and checks the sample piece. By recording on paper the defects obtained in that sample, and by repeated sampling, we obtain an index of the quality being produced.

Everyone has in his own mind certain features to look for and certain standards by which he judges a case. All we do

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George C. Lecky, Technical Director, F. J. Kress Box Co., Pittsburgh, Pa.

is set down these features and define the standards; some can be defined by means of definite measurements and others by visual standards. We have divided our visual standards into three classes—"good," "fair," and "poor."

1. Good—the best we can expect within its limitations when a machine is in A-1 condition.
2. Fair—not as good as is possible with our equipment, but good enough to be accepted by a customer.
3. Poor—that which we would reject if we were purchasing the case.

Forms are provided for listing the quality of the samples taken from the corrugator, slitter, printer, taper, or other machines. There is room on each sheet for taking eight samples per shift; however, any number can be taken if the same number is taken from each shift or operation, with a minimum of five.

The method of sampling is as follows: (1) pick up a random sample of the production being run, (2) look at that sample for points listed on form. For example, if a printed case was picked up you would look at it for: (a) clean slotting, (b) misslots, (c) quality of printing, (d) crooked case, and (e) short case.

If a case is picked up and you find that the slotting is clean, a rating of 10 points would be given for the clean slotting. If the slotting, while clean, is outside the slitter score by $^1/_8$ in., we would rate that as 5. If the quality of printing was only fair, we would rate this as another 5. If the case is straight we would rate that as 10. If the case blank is found to be $^5/_{16}$ in. short, we would have to give this a zero. These you would record on the form and your final score would be as follows:

Clean slotting	10
Misslot	5
Printing	5
Crooked	10
Short case	0
Total	30

Had there been no errors on this case, 10 points would have been given each of the five items checked or a total score of 50. The quality rating would then be figured as the actual score obtained, which in this instance was 30; dividing by the potential score of 50 gives 0.60; this multiplied by 100 gives a quality rating of 60 for the case. Succeeding samples taken that day from the same printer slotter would be recorded in succeeding columns. At the end of the day the quality rating for that operation would be the total of the individual quality ratings divided by the number of samples taken.

Where more than one crew is involved in a day's operation, it is possible to obtain a quality rating for each operator as well as the machine itself. Machine defects can be detected and controlled by watching the over-all ratings for the various divisions such as clean slotting, misslotting, etc. For example when a machine has a new set of slotting knives installed the slotting should all be clean. As time goes on, obviously the rating for clean slotting should begin to drop. Observation of this rating over a period of time will give us the experience necessary to set up quality rating limits which would tell us when the knives need regrinding or replacement.

The corrugator is probably the most important machine as far as determining quality is concerned. It is not only the first operation, but poor board (board that is soft or not properly adhered) cannot be satisfactorily fabricated in succeeding operations, resulting in excessive waste and poor quality boxes. We put special emphasis on this operation. We not only rate the machine by our quality rating system, but we also have samples of production sent at regular intervals to the laboratory where they are calipered, tested for flat crush, and checked for adhesion. A reduction in caliper and flat crush is always an indication of trouble at the corrugator which, if caught before it becomes too serious, can save you a lot of plant trouble both productionwise and qualitywise.

Quality charts are placed at each machine and quality averages for each phase of the operation are posted each week. In this way each operator can see his rating in relationship to the rest of the operators, and how the production from his machine compares with the production from other machines. Also, as the quality man rates each sample he puts it and the grade beside the machine where the operator can see it. In this way each operator is trained to know what our quality standards are and how near he is to meeting them.

As you can see, our approach to this problem has been to train the people to know what quality is and to teach them to operate their equipment at quality levels. In our operation most material is taken from the machines by hand and there is sufficient time for each operator to inspect his work and make any changes necessary to assure a quality job. Quality control has not tried to relieve the production department of its responsibility for maintaining quality, but has just given it a tool which it can use to solve the problem itself.

The foreman, if he uses this information correctly, can see what operators need his supervision most and what equipment should be next in line for maintenance.

There is always the danger when using visual standards that our concepts will change and one person will be grading differently than another as time goes on. We have tried to combat this by having the laboratory continuously grade random samples of finished production. The grades arrived at for the various operations are compared with those from the plant. If there is an appreciable difference between the two average grades, we check to see who has wandered off the standard.

We are continuously revising our standards, usually upward, due to better equipment, improved production methods, complaints, and comments from customers.

In conclusion, I would like to sound a warning that no quality control method ever improved quality by itself. Proper use by the production department of the information shown by quality control studies will assist in producing a quality product. The very fact that you install a system for quality control may, by its psychological effect, give a temporary lift to your quality. However, unless you follow through and take action when the ratings show that action should be taken, you will soon find that you are worse off with the system than you were without it.

Quality level	*General impression*	*5 Dies*		*5 Ink match*	*5 Printing*					*Total, %*
		Condition	*Mounting*		*Coverage*	*Definition*	*Smear*	*Register*	*Trapping*	
A + 5										81–100
B + 4										61–80
C + 3										41–60
D + 2										21–40
E-80										....

Deinking by the Froth Flotation Process

J. W. JELKS

THE historian Herodotus wrote: "If this be true I do not know; I but write what is said." Then follows a description of the method by which Gyzanthian maidens drew up gold dust by dipping pitch-covered feathers into the mud.

This bit of history indicates that the ancients had knowledge of the adhesive forces used in the modern froth flotation process. However, as in many instances, the application of these forces to the benefit of civilization had to wait until the first part of this century to be applied. Still another 50 years were to pass until the process was applied to the paper industry.

MECHANICS OF THE FROTH FLOTATION PROCESS

The froth flotation process is a basic separation method which depends on difference of surface conditions to separate various kinds of particles from a slurry. To effect this separation the material to be removed from the slurry is attached to an air bubble but in order to do this a specific type of air bubble is required. It must remain free and essentially the same size as when it was generated. This is accomplished by the use of a frother. Frothers are slightly ionizing chemicals consisting of a carbon hydrogen chain and one hydroxyl group. Typical frothers are the higher alcohols, phenols, and other materials having the structure just described.

To attach the particle of material that is to be removed to the air bubbles a collector is used. A collector must be highly selective and must seek out the material that is to be floated and must ignore the other materials present in the slurry. It must also have a very strong attraction for the bubbles. Collectors are generally highly water-repellent materials such as the fatty acids, hydrocarbon oils, and a long list of other materials.

Activators, depressants, and modifiers are applied to alter the basic characteristics of the reagents just described.

Since the forces that make the process operate by attaching the materials to be removed to an air bubble by means of a selective collector are purely due to surface difference it should be understood that the froth flotation process operates independently of size, specific gravity, and the phenomena used in the conventional methods of deinking. Due to the nature of the process, water becomes a mere working medium rather than an active part of the process.

However, since a water medium is used and a stable bubble in a water medium is a rather small one, a definite physical size limitation is set up. As applied to the deinking of paper, any particle from about −8-mesh to the larger colloidal particles can be handled.

APPLICATION OF PROCESS TO DEINKING

Since Alcide Fromet's British patent of 1903 describing a method of attaching a sulphide mineral to a gas bubble formed by the action of acid on a mineral, the first mention of applying the froth flotation process to paper is noted in the work of Pierre Hines of Portland, Ore. The first commercial installation in operation for deinking of paper stock was made about 2 years ago by the author.

Although there are an infinite number of objectionable materials that must be removed from wastepaper before it can be re-used in high-grade papers, there is one outstanding point in favor of using their surface conditions as a means of eliminating them. By far the greater part of the objectionable materials encountered has been designed to adhere to a dry sheet of paper. As the dry paper generally has a pH near neutral or slightly acid the objectional materials can generally be removed by pulping the paper in an alkaline detergent solution.

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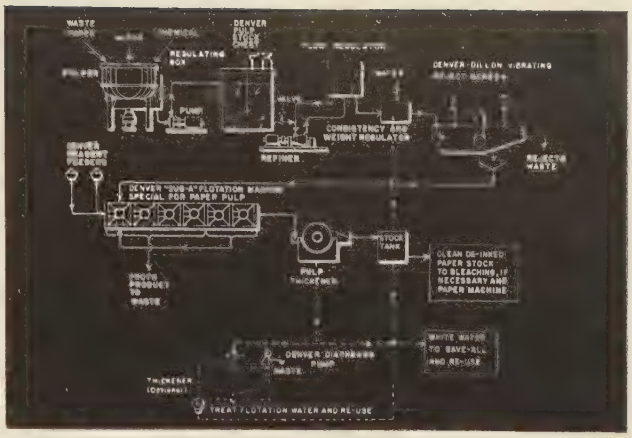


Deinking paper pulp by flotation

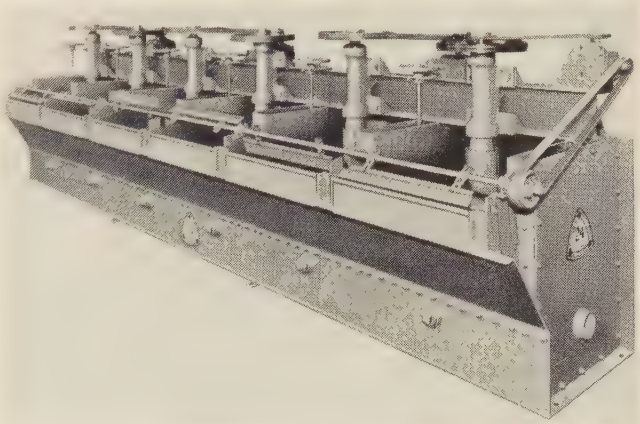
Due to their similarity in the beginning a strong similarity of surface condition generally remains after pulping. It is this similarity that so favors a deinking method based on surface condition to separate the good fiber from the unwanted materials.

In order to use the froth flotation process for the removal of these unwanted materials, it is first necessary to pulp the paper to form a slurry in which the ink or other objectionable particles are separated from the paper fiber. This is generally accomplished in a hot or warm alkaline medium, although some work has been done using slightly acid detergent mediums that show promise in specific applications.

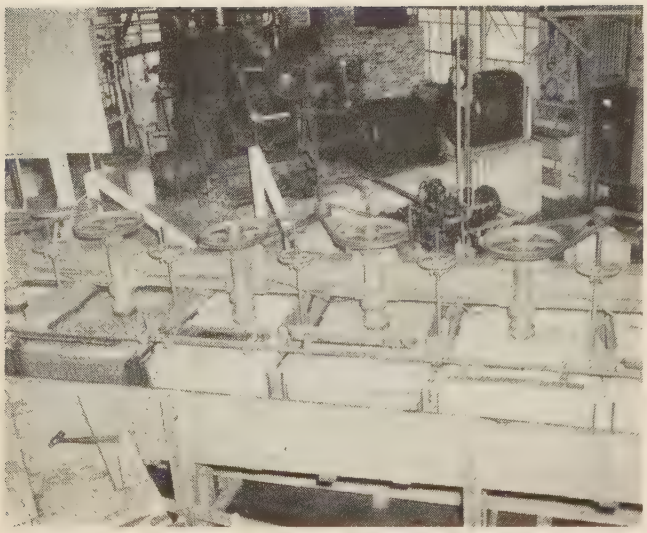
To remove the objectionable materials from the slurry the paper is diluted to a consistency of near 1% at which point pine oil, du Pont B-22, or B-23, or other typical frothers and a collector are added. Kerosene, xylene, etc. are typical collectors. Special combinations are resorted to when the above reagents are not sufficient to handle all objectionable materials.

The above slurry is agitated and aerated simultaneously in a flotation machine. A Denver "Sub A" flotation machine of special arrangement is used. Much time and development were devoted to obtaining the best conditions for this stage which resulted in the aforementioned machine. The ink and other objectionable materials are raised to the surface of the flotation machine where they are removed. The accepted stock is then bleached and is ready for use in the paper furnish.

Newsprint—equal or superior in every respect in bursting strength tear, brightness, etc.—has been made from a furnish of 90% old newspapers and 10% magazines that were cleaned up by the froth flotation process. An excellent grade of facial tissue is manufactured from old papers that are cleaned up by froth flotation. Old papers cleaned up by this process



Denver Sub-A flotation machine used in paper pulp



Denver Sub-A flotation machine at Herty Foundation Laboratory used to deink newsprint for remanufacture into newsprint

have also been successfully used in patent coated boards and in the manufacture of fine papers.

PERFORMANCE

When applied to deinking the froth flotation process produces notable performance. As the process is extremely selective a fine dividing line between ink and paper can be drawn. Shrinkages of $2^1/_2\%$ or less are frequently noted, even with magazine stocks, as the fillers can be retained.

The paper stock is generally much brighter than washed stock as flotation much more effectively removes carbon particles than does washing. Due to this fact it is possible to make deinked stock with brightness and color similar to virgin pulps.

Because of the nature of the froth flotation process water is used as a working medium rather than an active part of the process. This makes it necessary only to lose the water contained in the froth which makes possible a water loss as low as 500 gal. per ton of paper processed.

Cost of operating is generally lower than conventional methods. This is due to the fact that the amount of cooking chemical can generally be reduced as it is only necessary to make the ink separate from the paper fiber. Since it is not necessary to make the ink particles small enough to wash through the fiber mat the smaller amount of chemical is sufficient. In addition to the cook chemical, the frothers and collector and other materials are required. These generally amount to less than $1.00 per ton as the materials generally used are low priced and the quantity involved is small, consequently, the total cost of using the flotation process is generally lower due to the savings in cooking chemical.

FUTURE

Since particle size is not a prime factor in the froth flotation process it is feasible to remove objectionable materials that have, in the past, completely rendered otherwise good fiber unusable, even though a very small amount of the objectionables were present. To date, considerable work has been done on some of these materials which indicates that asphalt, cover varnish, and certain bindings can be handled.

Rubbers, especially the uncured types that are used in pressure sealing-type tapes, have had a lot of time devoted to them. It has been possible to remove this material by flotation, but the results have not been consistent. However, it is thought that the reasons for this inconsistency have now been determined.

Laboratory work indicates that there is a good chance of treating the froth rejects in a manner that will eliminate the waste effluent from the deink plant, and it is hoped that before the end of this year that a successful deinking plant with no waste effluent can be reported.

CONCLUSION

By applying these methods to the recovery of wastepaper the paper industry now has available a means of correcting many of the objectionable features of using wastepapers.

The froth flotation process promises to solve many of the old problems of wastepaper use such as stream pollution and handling of new difficult materials that will not wash out while at the same time giving a higher yield of a better, cleaner, and brighter product.

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A Suggested Test Method for the Determination of the Efficiency of Reject Removal

GEORGE B. NICHOLSON, JR.

For many years, testing methods for the pulp and paper industry have been under consideration, both by individuals and TAPPI sponsored committees. The various testing methods which have resulted have made possible a great deal of technical progress since the use of uniform and standardized procedures permit the exchange of data on products and processes.

However, one of the more important test procedures, that of determining the amount of rejectable material in pulp, has never been reduced to an entirely satisfactory method. There are many reasons for this but it is apparent that the need, or necessity, for such a test is not one of them.

As anyone who deals with the processing of waste materials knows, the two factors: (1) paper, felt, or paperboard quality and (2) equipment maintenance are to a large extent proportional to the amount of rejectable materials in the pulp as it passes through the stock preparation system and as it reaches the paper machine vat, or headbox. Therefore, it is of considerable importance not only to develop equipment to efficiently remove these rejects but also to measure the performance of this equipment with a suitable testing method. Naturally, equipment manufacturers are also vitally interested in a test procedure of this kind so that new equipment can be properly developed and so that present equipment can be properly applied and corrective measures taken in the field.

An ideal test method for this purpose would be one which is comprehensive enough to cover all types of rejects, regardless of size or density. In practice, it would be difficult, if not impossible, to conceive of such a method, and several procedures, each of which covers a specific range of operation, will undoubtedly be required.

The objective of this paper is to describe one of these specific methods with the following limitations: (1) The method will only be used to measure the relative difference in the amount of rejects at two points in the same system. (2) The rejects must have a specific gravity greater than 1.0 (specific gravity (average) of pulp). (3) The reject particle size should be small enough to pass through a 6-mesh screen and large enough to be retained on an 80-mesh screen. These limita-

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tions appear to be rather severe, but actually the method has wide application and it is to be hoped that other specific methods will be developed which will be useful for those problems not covered by this one.

PRESENT METHODS

Before discussing the proposed method in detail, it would be well to examine present methods and discuss the reasons why these are not satisfactory. Here, again, we are speaking primarily of heavy reject evaluation within the range of 6 and 80-mesh.

Now, we must consider three factors in any testing procedure. The first of these is that of obtaining a suitable and representative sample, the second is that of analyzing the sample, and the third is that of reporting the results so that they can be used to best advantage. Taking these separately, but not in the order given above, we can evaluate methods now in use.

Analyzing the Samples

There are essentially two methods in use for this purpose. The first of these consists of obtaining the total oven-dry weight of the sample and then burning the entire amount down so that all combustible material is reduced to a fine ash and, finally, disintegrating the ash in a ball mill and separating it from the noncombustible material by washing on a fine screen. This leaves the rejects in a relatively pure form so that they can be fractionated. One modification of this method is to obtain a representative sample of the main sample, determining the moisture, and then calculating the oven-dry weight of the large sample. From practical experience, however, this is not to be recommended since it appreciably increases the error.

The second method consists of making standard weight handsheets and counting the particles or rejects within a designated area and then transposing this into a calculated percentage of rejects in the entire mass.

Each of these methods is relatively time consuming and is subject to some error during the analysis. However, from practical experience, it has been found that the first method is less subject to the human element, is relatively more accurate if a large sample is available and, if proper equipment is available, it requires less time for processing. The second method, however, has the specific advantage of allowing for the identification of the rejects in their original form and the calculation of the percentage of each type present by material as well as size.

A third method has also been used which consists of a continuous decantation of the sample, either by using a series of dilutions with subsequent removal of the floating pulp fibers or by using an elutriation process. This method probably has the greatest error unless a very careful procedure is used, and is certainly the most time consuming if the sample is large.

Reporting the Results

Using either the first method or the last, proposed above, the sample can be fractionated and the results reported as percentages of the various components, based on the screen sizes used. Various combinations of standard screen sizes of 6, 10, 20, 40, 60, 80, 100, and 200 mesh are commonly used.

Using the speck count method, it is only possible to report the percentage of total rejects or, at best, the various components based on the area of the particle and the type.

There has been no standardized method of reporting results and this has largely been determined by the individual investigator, depending on the type of system being evaluated.

Obtaining a Representative Sample

This has been left as the last item under discussion because of its relative importance in any testing procedure which involves the collection of samples from large volumes or flows and because so little attention has been given to this phase of testing in grit removal systems.

Present known methods are all based on a discontinuous collection of samples and the procedure varies widely, depending on the scope of the test work and the individual operator. It is usual, however, to collect samples of stock, both before and after the grit removal equipment under test, at periodic intervals over a sufficiently long period of time to reduce the error of intermittent changes in the amount of rejects present in the stock.

This is a very general procedure and will change with conditions in each mill, although it has been found to be impractical to collect over 3 gal. of sample per 15 min. from each sampling point or to continue the test for over 24 hr. duration.

Now, if intermittent sampling of 3 gal. per 15 min. is the best procedure which can be practically used, let us examine the accuracy which we might expect from this sampling. If we assume a very small flow of 500 g.p.m., we find that, over a period of 15 min., we have passed a total of 7500 gal. over the sampling point and from this point we then collect 3 gal. This would represent only 0.04% of the total, which would, of course, be a ridiculously small sample and well beyond the definition of an adequately large one.

Now, let us consider the relative difficulty of obtaining a representative sample from a stock line in which the reject concentration fluctuates continuously and where other variables such as consistency and flow rate changes can also exist. Here, for practical reasons, we find that it is almost impossible to sample the same flow of stock in a system from two separate points since it would be necessary to time the flow between the two points to a very high degree of accuracy and then to collect the samples with an exact time differential. This, of course, would introduce another factor which would be the inability to properly clear the sample lines unless these were kept flowing for substantially long periods of time and the entire reasoning of possibility must be predicated on an absolute uniformity of flow rate with no substantial storage point between the sample points.

For these reasons, we feel that discontinuous sampling introduces an error of such a large magnitude that it becomes the greatest disadvantage of present methods to be overcome.

PROPOSED TESTING METHOD

Although most of the factors involved in setting up the proposed test method have already been mentioned, as well as the limitations which must necessarily be imposed, it seems desirable to sum these up at this point. These are:

1. That continuous sampling must be used and the sample flow must be an appreciable percentage of the total flow.
2. That the sample must be processed continuously to remove the rejects and the cleaned stock returned to the stock preparation system in order to prevent waste and to reduce the actual sample, which will be analyzed, to a working size.
3. That the method is limited to the collection of samples from two points. This is not a theoretical limitation but rather is imposed for practical reasons since a considerable amount of equipment is required and this requires careful observation during the test.
4. That the method is limited to the collection of samples which contain rejects of specific gravity greater than 1.0 and of a size between 6 and 80 mesh.
5. That the method is theoretically based upon the premise that the relative difference in the amount of rejects in two different samples can be determined without knowing the total concentration of the rejects in either sample, if the same percentage of rejects is recovered from each sample and if the sample sizes are equal. This, then, indicates that each sampling unit must be equal in efficiency and that the two continuous samples must be equal in flow rate.

Generally speaking, the method employs a separate continuous sampling device at each test point. The continuous sample is then processed to remove the rejects and the cleaned stock is passed back to the main flow. This satisfies the basic

problem of concentrating the sample for analysis with a minimum waste of stock.

Reference to Fig. 1 shows the equipment necessary to accomplish this.

At points A and B it will be noted that sample lines are inserted into the stock lines in a uniform manner. It is, of course, very difficult to obtain a perfect sample from within a pipe but the error can be reduced to a minimum by using the same arrangement at each point and ensuring that this is not located near a turbulence point such as a pump or a fitting in the line. Also, the actual location of the sampling pipe relative to the main flow is of considerable importance. Figure 2 shows the recommended procedure for this.

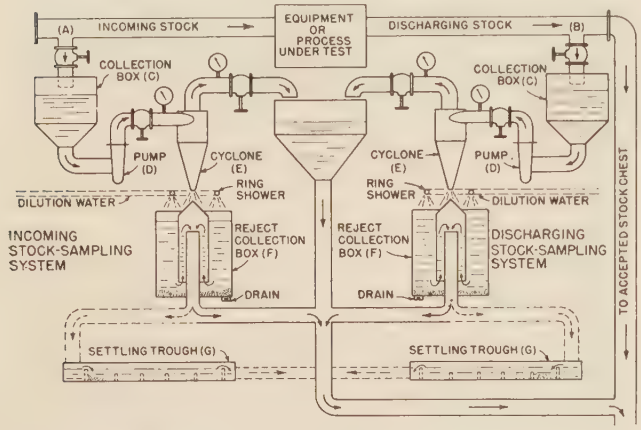

Fig. 1. Equipment layout for reject removal efficiency test

It is important to note that, from the sampling points, duplicate arrangements of equipment are used on each side. This is extremely important since this, in effect, cancels the variables of flow encountered in unequal piping systems.

Since the sampling systems are exact duplicates, only one will be described. The sample flows into a simple, conical bottom, collecting box, C, to provide a uniform inlet pressure, independent of the pressure in the stock line, for the pump, D, which raises the pressure to accommodate the characteristics of a small cyclone, E, which is constructed in accordance with normal cyclone design and which employs a free-flowing discharge of rejects. At this point, the concentrated rejects are separated and processed further and the accepted stock from the cyclone is returned to the main stock flow.

The concentrated rejects are diluted to a very low consistency by means of a ring shower at the cyclone discharge and are settled from the stock in a one or two-stage settling device.

In the single-stage device, a construction as shown in Fig. 3 is employed. The rejects and stock enter on the outside section of the circular chamber with the dilution water, and pass down the outside and up the inside chamber to the overflow pipe, with the rejects being dropped at the bottom of the chamber. It should be noted that the flows in these chambers are set very low in order to obtain high efficiency, since the deposition of a small amount of pulp with the rejects is not objectionable. The accepted stock is returned to the main stock flow to prevent waste.

In the two-stage device the accepted stock from the primary settling chamber is passed to a very shallow settling trough, as shown in Fig. 4. Here again no effort is made to prevent pulp settling and flows are maintained at a low level. The cleaned stock from the settling trough is also passed to the main flow stock chest or system. At this point, it might be well to point out that, although the settling trough appears to have a higher efficiency than the reject collection box, it would be impractical to use it alone since a large build-up of rejects in the trough would cause channeling of stock into high flow rate patterns with a consequent reduction in efficiency and a nonuniformity in efficiency between systems.

During actual operation of the system it is extremely important to adjust the stock flow from each sample point so that exactly the same amount is processed on each side. It will be noted that this method not only cancels consistency changes, provided there is no change between the two sampling points, but, more important, it provides samples of equal size and relieves the operator of the necessity of drying the sample before analysis.

Stock flows are best adjusted on a volume-time basis at the beginning, to ensure accuracy, and during the test period, gages can be used to maintain the adjustment. At this point, it should be noted that the pumps and small collecting boxes are always used, regardless of the pressure available at the sample lines, so that uniform conditions can be maintained.

In addition to the above, the flows must be adjusted properly to ensure that the cyclones are operating correctly. This can easily be done by observation of the spray discharge from the tapered bottom piece.

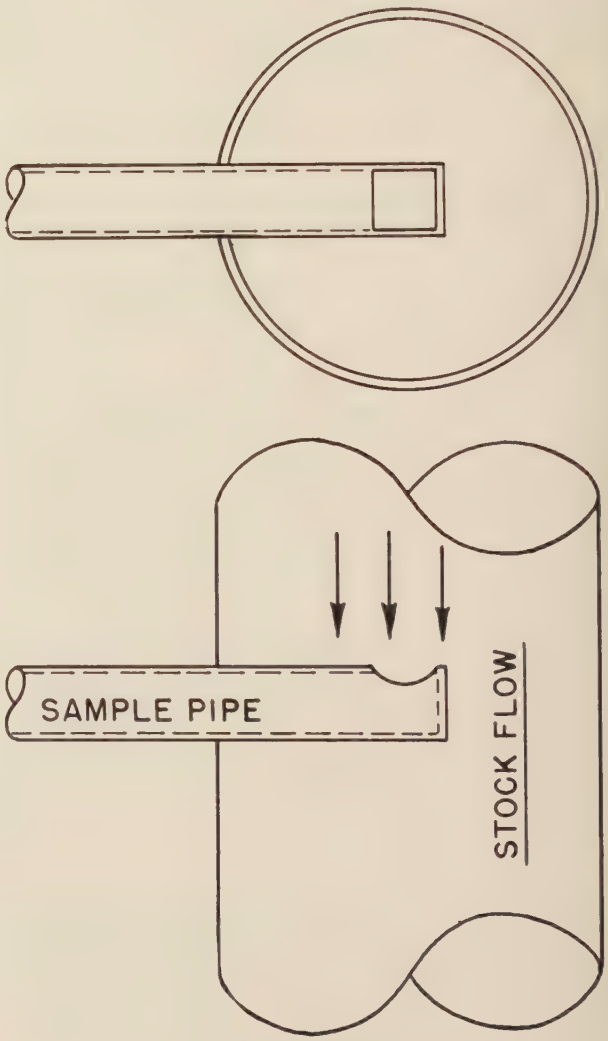

Fig. 2. Sampling pipe design

After all flows are adjusted and equalized, the run is started, using clean settling chambers, and during operation the technician carefully observes the functioning of the equipment for changes in flow and malfunctioning of apparatus. The time of operation can be varied, although a 2-hr. period has proved quite satisfactory.

After the run is made, the entire contents of the settling evices are transferred to a fine mesh cloth bag and drained. hese samples are then processed by the previously described ocess, as follows:

The contents are transferred to stainless steel canisters and irned down to a white ash. This ash is then transferred a ball mill to break up the ash particles and these are subseiently washed through a 150-mesh screen, dried, and fracnated on U. S. Standard sieves.

Results can be reported to suit the particular requirements the investigation, although we have found a method similar Table I to be very suitable, since it furnishes a complete cture of the results.

TEST DATA

Although the test method appeared to be theoretically rrect, it was obviously desirable to not only examine each eoretical aspect but to fully test the method to determine e degree of error to be expected.

Since the method is based primarily on the premise that the mpling equipment need not be 100% efficient with regard to noval of rejects from the sample, but that each sampling stem must be the *same* in efficiency, it was necessary to ove that this would not involve an incorrect calculation. his was easily done by several sample calculations.

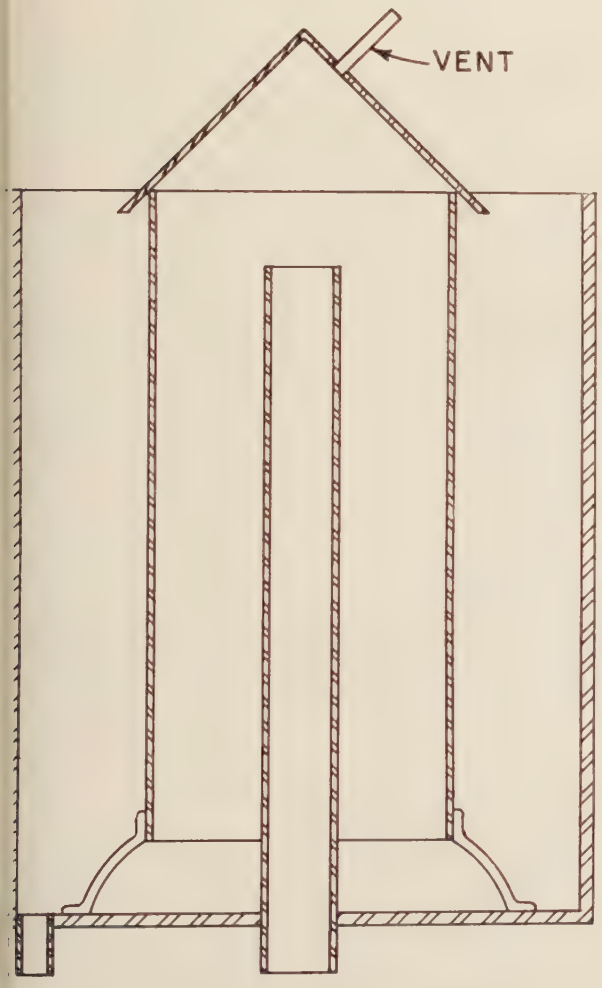

Fig. 3. Reject settling box (primary)

In other respects, if the above premise is correct, the equipnt is theoretically correct in application, although it is e obvious that it is desirable to maintain a reasonably high ree of efficiency in the sampling system, since this tends to mote greater over-all accuracy.

In order to properly test the method, equipment was set up in the pilot plant which was designed to introduce a measured amount of known rejects into two similar sampling systems to simulate actual sample lines. Figure 5 shows the method used.

Since there might be some question on the true division of a common stock line into two equal flows containing the same amount of rejects, two calibrated continuous reject feeders were used, one for each sampling system. These, of course, were calibrated and adjusted to give the same feed rate before the tests were started, but, in addition, a calibration was made immediately following each test run, for the same time as the run, so that the exact amount of rejects added was obtained.

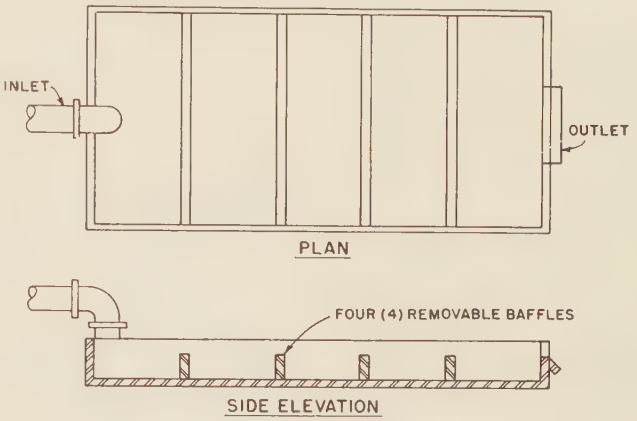

Fig. 4. Reject settling trough (secondary)

Using this equipment, tests were conducted using clean graded quartz sand as the reject material and clean folded news as the pulp. Table II shows the results of the tests as well as the detailed conditions of the various trial runs.

Several very interesting relationships can be seen on this chart, but of principal interest at the moment are the two columns on the right. These show conclusively that the experimental error in the sampling procedure is relatively small and it proved to our satisfaction that the method was sufficiently accurate for use. Also, of primary interest is the relative amount of rejects found in the primary and secondary settling devices.

It can easily be seen that for relatively large rejects (large enough to be retained on a 20-mesh screen) that primary settling box is entirely adequate. This allows for less equipment and time in running a test where the evaluation of these rejects is all important. On the other hand, on rejects smaller than this, the use of a secondary settling device is very important in order to obtain a satisfactory accuracy and, for tests where relatively fine rejects are important, the two-stage system is necessary.

PRACTICAL ASPECTS

Two practical examples are given which show the relative value of this system compared with the best method previously used.

Using what was considered to be the best method previous to the proposed one, two research engineers collected samples over a period of 24 hr. from a wastepaper system. In this system there were four critical sample collection points and a 3-gal. sample was taken every 30 min. from these points for the entire 24-hr. period. (In this case, a 30-min. interval was the smallest that was practical.)

As each sample was collected, it was transferred to a cloth bag which drained in the 30-min. interval between samples. Thus, at the end of 24 hr., approximately 12 lb. (moisture-free) of stock was collected from each sampling point. These

Table I. Suggested Method of Reporting Results of Reject Tests

Run No._____ Unit Being Tested_____ Remarks_____

Consistency (% O.D.)_____

Furnish _____ Date _____ R. E. _____

Before sample (A)	*After sample (B)*	*Before sample (C)*	*After sample (D)*	*Screen size*	*Per cent efficiency*	*Per cent efficiency (additive)*	
Weight of rejects, grams	*Weight of rejects, grams*	*Particle distribution, %*	*Particle distribution, %*	*U.S.S. Mesh*	$\frac{A-B}{A} \times (100)$	$\frac{A-B}{A} \times (100)$	
				R-10			
				R-20			
				R-40			
				R-60			
				R-80			
				P-80			
				R-200			
				Total			

were subsequently taken to the laboratory where they were dried to obtain the sample weight and then burned down to recover the noncombustible rejects. Following this, the

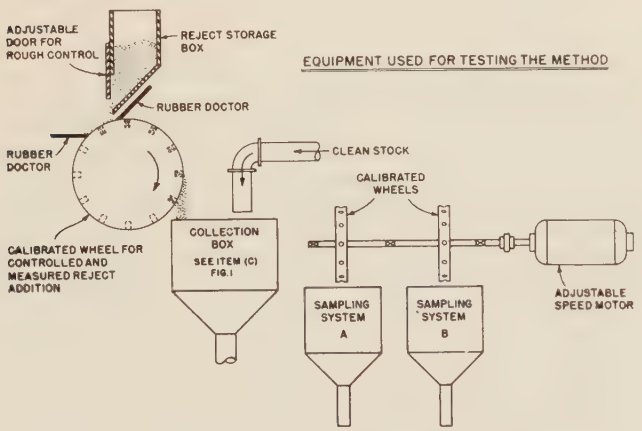

Fig. 5. Equipment used for testing the method

standard procedure of sieving was followed and, from these data comparative efficiencies throughout the system were obtained.

Strangely enough, in spite of very careful work, it was found that in each of the units tested, more rejects were found in the discharged stock than in the incoming stock, which made the complete experiment valueless. In addition to this it was found that over 30 man-hr. were required for each sample to simply dry and burn the material.

As noted previously, the poor results were undoubtedly due to the sampling procedure since this was a 150-ton per day system, and consequently, flows in the order of 2500 to 3000 g.p.m. were obtained. Quite obviously, a 3-gal. sample from 4500 gal. is inadequate. Also, with regard to experimental error, it is noteworthy to add that each sample contained only about 15 to 35 grams of rejects and in view of the relatively inaccurate procedure employed for analysis, this would not be ordinarily considered as an adequate amount.

This one example explains the most desperate need for an adequate method to test grit removal systems.

In contrast to this, a set of preliminary experiments might be explained which were conducted on a new piece of grit removal equipment which was tested last Summer, using the proposed system.

In this case, there was a flow of approximately 1000 g.p.m. through the unit under test and an attempt was made to determine the relative efficiency under various settings of the internal mechanism. Under five different settings, which covered the extremes as well as the optimum expected condi-

Table II. Results of Test Runs to Show Accuracy of Reject Removal Test Method

Run No.	*Cons., %*	*Reject size*	*Total Gms rejects added*		*Gms rejects recovered, collecting box*		*Per cent recovered, collecting box*		*Gms rejects recovered, settling trough*		*Per cent recovered, settling trough*		*Total Gms rejects recovered*		*Per cent efficiency total*	
			Cyclone 1	*Cyclone 2*	*Cyclone 1*	*Cyclone 2*	*Cyclone 1*	*Cyclone 2*	*Cyclone 1*	*Cyclone 2*	*Cyclone 1*	*Cyclone 2*	*Cyclone 1*	*Cyclone 2*	*Cyclone 1*	*Cyclone 2*
I	0.97	P-10	302	310	128	126	42.5	41.8	101	108	33.4	35.8	229	234	76.0	77.6
II	0.73	P-10	262	268	134	128	51.2	47.8	82	80	31.3	29.8	216	208	82.5	77.6
III	0.24	P-10	228	234	166	147	72.8	63.0	37	57	16.2	24.4	203	204	89.0	87.6
IV	0.51	P-10 R-20	181	188	165	160	91.0	85.0	000	000	00.0	00.0	165	160	91.0	85.6
V	0.50	P-20 R-40	121	123	90	93	74.0	75.5	9	10	7.4	8.1	99	103	81.7	83.6
VI	0.48	P-40 R-60	214	237	144	137	67.3	57.8	26	54	122.0	22.7	170	191	79.5	80.5
VII	0.49	P-60	153	146	51	43	33.4	29.4	62	63	41.0	43.2	113	106	74.4	72.6
VIII	0.00	P-60	305	323	261	290	85.5	89.8	20	16	6.5	4.9	281	306	92.0	94.7

All rejects are clean graded quartz particles. All pulp is clean folded news.

ions, the relative efficiencies were found, and these were subsequently confirmed by a second series of runs with agreement within 5%.

The significance of this test can be further exemplified by the fact that it was possible to make each set of trial runs within a 2-day period and, by virtue of the concentration of the rejects into a relatively small fiber-free condition, it was comparatively easy to process the concentrated samples during a subsequent 2-day period, with only one research engineer and a technician being used. This resulted in only 12 man-hr. per sample for the complete test, including the sample collection. At this point, it should be noted again that it is unnecessary to air dry the samples since the total weight recovered from a known flow over a known period of time is the basic factor and, again, by concentration, a very large sample of grit is obtained which materially decreases the experimental error during analysis.

It should be stressed that this is only a proposed method and, even if generally acceptable, there are many improvements that can be made on the method, and the problem of expanding the method to cover a wider field of testing still remains. It is hoped that progress will be made along these lines.

RECEIVED Jan. 22, 1953. Presented at the 38th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 16–19, 1953.

RECENT BOOKS

Platen Press Operation. By George J. Mills, Pittsburgh, Pa., 1953. Cloth, 8½ × 11, 150 pages. 240 illustrations. $6.00.

Professor Mills' book on "Platen Press Operation" is a sequel to his education monographs on Sources of Information in American Graphic Arts and Paper Cutting: Machines and Techniques. It was written both for the student learning about platen presswork and for the journeyman press operator to improve his efficiency of techniques and improve the quality of the jobs which he prints.

The volume covers the following subjects: the four major processes, presses used in letterpress printing, parts of the platen press, make-ready, hand feeding, the Chandler, Price, Kluge, and Heidelberg presses, forms requiring special preparation, printing papers, inks, rollers, original and duplicate plate.

The chapter on printing papers covers this general classification, how to select the correct paper, calculations of the amount needed, storage of paper, how to cut paper efficiently, and safety measures.

The book should be ordered directly from George J. Mills, Carnegie Institute of Technology, Pittsburgh 13, Pa. Make remittances payable to Professor Mills.

Metallurgical Dictionary. By J. G. Henderson, Consulting Engineer, and J. M. Bates. Reinhold Publishing Co., New York, 1953. 6 × 9, 416 pages. $8.50.

The author states that 14 years ago, as a mechanical and materials engineer in the field of industrial standardization, he was faced with the problem of putting metals to work through standardization. This demand led to the preparation of the present book which assembles in concise form, definition of those terms considered essential to both professional and the layman in understanding metallurgical literature. Several hundred definitions are given.

Materials for Product Development 1953. Clapp & Poliak, Inc., New York, 1953. Cloth, 6 × 9, 265 pages. Illustrated. $7.50.

"Materials for Product Development" consists of the proceedings of the Basic Materials Conference held in conjunction with the First Basic Materials Exposition held in New York City in June, 1953. It is a compilation of the addresses given by individual speakers.

Included in the volume are such subjects as Economics of Engineering Materials, Aluminium, Titanium, Sandwich Construction, Plastics, Insulating Materials, How to Select and Specify Materials, and Materials for Roller Bearings.

Copies of this volume should be purchased from Clapp & Poliak, Inc., New York 17, N. Y.

Note: Books reviewed in this section may, unless otherwise noted, be obtained from the Book Department, Technical Association of the Pulp & Paper Industry, 155 E. 44th St., New York 7, N. Y.

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THE UTILIZATION OF SULPHITE WASTE LIQUOR

A Bibliography of the Literature Published During 1952

H. BORDEN MARSHALL and JANETTE M. NEATE

AMMONIA-BASE PROCESS

BISHOP, F. F., and HONSTEAD, J. F., *Tappi* 34: 318–323 (1951); *C.A.* 46: 255 (1952).

The Palmrose method (*C.A.* 29: 1629) has been combined with the formal titration to give total and free SO_2 and NH_3 analyses on the same sample of ammonia-base sulphite liquor. At the end of the Palmrose titration, HCHO is added to the solution and, after 1 min., the liberated H_2SO_4 is titrated to the phenolphthalein end point with $Ba(OH)_2$ to obtain the NH_3 analysis. A system is described for the laboratory preparation of ammonia-base liquor. Curves are shown which indicate that, at a known NH_3 content, the total SO_2 content can be estimated by pH measurement.

JONES, R. M., and DETCHER, T. E., *Paper Trade J.* 133, No. 5: 20, 22, 24, 26, 28 (1951); *Paper Mill News* 74, No. 36: 12–16 (1951); *Pulp Paper Mag. Can.* 52, No. 11: 116–122 (1951); *C.A.* 46: 734 (1952).

The NH_4HSO_3 process is contrasted with the calcium-base sulphite process. The rate of diffusion of the NH_4 ions is much higher than that of the Ca ion; the NH_4 salts of many acids found in the digester during the cooking process are more highly soluble than the corresponding calcium salts. Cooking conditions are very similar, except that the time is 6.25 as compared with 7.5 hr, and the combined SO_2 may be lower (0.9 compared with 1.2%). The pulp prepared by the NH_3 process has improved properties. The recovery of the waste liquor is discussed; evaporation and burning appear to be the most applicable solution.

WADDELL, R. D., *Paper Ind.* 33: 1442 (1952); *C.A.* 46: 4224 (1952).

A description is given of conditions in one mill where pulp mill capacity, pulp yields, and strength have improved and in which maintenance has decreased. Although chemical costs increased, as did slime trouble and darkening of (unbleached) pulp, Waddell feels that the disadvantages are not serious deterrents.

DETCHER, T. E., and JONES, R. M., *Paper Ind.* 33: 1438–1442 (1952); *C.A.* 46: 4225 (1952).

A brief history of the development of the process. D. and J. discuss the process, raw materials, and equipment used, the importance of corrosion and its mitigation, the acid manufacture, digester operation, and waste-liquor disposal. Ammonia-base is compared with calcium-base pulping and comparative operating conditions and pulp properties are tabulated (based on a hypothetical set of mill conditions, which themselves are the composite of several different operations). In general ammonia-base is favored over calcium-base. Recent experiments show that ammonia-base can be used in pulping maple and beech, and even in delignifying jack pine (high in heartwood). Ammonia-base is attractive economically, inasmuch as it permits an increased output. At present, however, NH_3 is not economically recoverable for reuse.

H. BORDEN MARSHALL, JANETTE M. NEATE, Ontario Research Foundation, Toronto, Ont.

PALMROSE, G. V., and HULL, J. H., *Tappi* 35: 193–19 (1952); cf. *C.A.* 45: 8764 (1951); 46: 7326 (1952).

Pilot plant experiences on evaporating and burning am monia-base waste sulphite liquor are described. By usin the Rosenblad system, 9% waste sulphite liquor was evap orated to 50% solids with an efficiency of 0.888 lb. of H_2 evaporated per lb. of steam. The concentrated liquor wa successfully burned to give 5.3 lb. steam per lb. solids. S was recovered by scrubbing the flue gases with NH_4 solution The sulphur recovery amounted to about 80% of that in th waste liquor or about one-half that normally lost in blow gase and waste liquor.

HELLEUR, D., U. S. pat. 2,596,241 (May 13, 1952); *C.A* 46: 7330 (1952).

Waste sulphite liquor (from the ammonia-base process from the washers is treated with MgO (with or without pre stripping SO_2) to liberate NH_3, concentrated in multiple effect evaporators, and burnt. The SO_2 in the combustio gases is recovered by means of the NH_3 liberated by the SO and the MgO is recovered from the combustion ash. Th cooking acid can be ammonia-base or combined magnesiu and ammonia base and can be acidic (excess SO_2), neutra or basic (excess NH_3). The $MgSO_4$ is added to the conce trated waste sulphite liquor prior to combustion, the SO_2 a liquid or gas is added to the cooking liquor, and NH_3 i added at the absorption towers.

BENSON, H. K., *Pulp and Paper* 24, No. 8: 74, 76 (Ju 1950); *B.I.P.C.* 20: 907 (1950).

The feasibility of the ammonia-base cooking process i discussed, and its advantages over the calcium-base sul phite process are listed. Although ammonia costs mor than calcium, its use as a cooking agent has shown a numbe of compensating factors, such as increased yield of pulp shorter time of penetration and cooking, wider choice i range of wood species, higher quality of pulp, and greater eas of operation and recovery processes for avoiding water an air pollution. In given cases these factors may well com pensate in dollar value for the difference in cost of the chemi cal reagents.

PAPER INDUSTRY, *Paper Ind.* 33, No. 12: 1438–1439 (March 1952); cf. *B.I.P.C.* 22: 54, 205–206; 22: 614 (1952).

The development of the ammonia-base sulphite proces in the United States is reviewed. Rayonier, Inc. was th first company to convert its sulphite mill at Shelton, Wash to ammonia-base pulping in 1945; since then a number o other mills on the West Coast, in Wisconsin, or in the Eas have adopted the process or are experimenting with it. On of the important reasons for the change-over from calcium to ammonia-base is the prevention of stream pollution; th conversion is relatively simple and required little modificatio of existing equipment. The liquor is exceedingly corrosiv on the conventional digester linings; however, these can be re placed gradually in a more or less normal replacement pro gram. Work is in progress on the development of a suitabl evaporator and heat-recovery furnace for the waste liquor.

Crown Zellerbach Corp., *Chem. Week* 70, No. 15: 34 (April 12, 1952); *Chem. Eng.* 59, No. 5: 230–231 (May, 1952); *B.I.P.C.* 22: 696 (1952).

A new product which is obtained from ammonia-base sulphite liquor is being manufactured for use as an adhesive, wetting agent, dispersant, soil conditioner, yeast nutrient, and chemical raw material. Trade-named Orzan, the product is essentially ammonium ligninsulphonate and wood sugar.

BASE EXCHANGE MATERIALS

Yahama, Y., Jap. pat. 3474 (Oct. 30, 1950); *C.A.* 46: 10492 (1952).

Waste liquor from sulphite pulp is concentrated to contain 20% solids, 20 ml. of which is treated with 8 ml. concentrated HCl and 4 ml. 30% HCHO 5 hr. at 100° to give 3.8 grams (95%) resin with a cation-exchange capacity of 0.00026 mole per gram. It can be regenerated by HCl.

Hachihama, Y., Jodai, S., Sato, H., and Fukui, E., *J. Chem. Soc. Japan, Ind. Chem. Sect.* 53: 365–367 (1950); *C.A.* 46: 11505 (1952).

Cation-exchange resin from sulphite-pulping waste liquid. See *C.A.* 45: 10659.

Anderson, C. C., Can. pat. 481,243 (Feb. 19, 1952); *B.I.P.C.* 22: 643 (1952).

A process for the production of an organic cation exchanger comprises the steps of treating waste ammonium bisulphite liquor with an acid cation exchanger, evaporating the liquor to dryness, heating further for 4 to 6 hr. at 105 to 110°C., and freeing the resultant brittle mass from its water-soluble constituents by boiling with water. The product has an efficiency of 1.16 milliequivalents per gram.

BINDING MATERIALS

Holzer, T., Swiss. pat. 272,159 (Feb. 16, 1951); *C.A.* 46: 1338 (1952).

Insulation board was made from waste wood pulp and protein by-products as binders. Thus 500 parts wood pulp and 150 parts waste sulphite liquor (6° Bé.) were mixed and the pH adjusted to 4.4 with alum. An acid extract of leather waste, 150 parts, was added and excess water drained off. The mixture was pressed at 170 to 220° under a pressure of 50 to 70 kg. per sq. cm. Soybean meal and yeast by-products may also be used.

Penn, J. E., U. S. pat. 2,579,481 (Dec. 25, 1951); *C.A.* 46: 2851 (1952).

An adhesive with desirable "quick tack" properties, particularly suitable for gummed tapes, results when the concentrated waste liquor (lignone) of the sulphite pulp process is treated with a small quantity, such as 1%, dry-weight basis, of H_3PO_4, then blended with about 10% polyvinyl alcohol (U. S. pat. 2,457,357, *C.A.* 43: 3198), and finally with urea or thiourea in the amount of 10 to 20% of the combined acid-treated lignone and polyvinyl alcohol. The gummed tape as well as the adhesive is covered by the patent.

Penn, J. E., U. S. pat. 2,579,482 (Dec. 25, 1951); *C.A.* 46: 2851 (1952).

The permissible storage period or useful life of gummed tape coated with the adhesive described in the preceding abstract is distinctly increased if a compound capable of releasing SO_2 when mixed with water is added to the lignone during that step in the manufacture when the H_3PO_4 is added to the lignone. Zn dithionite, in an amount equal to about 1% of the dry weight of the lignone, is a suitable compound.

Penn, J. E., U. S. pat. 2,579,483 (Dec. 25, 1951); *C.A.* 46: 2851 (1952).

The hygroscopicity and consequent "blocking" tendencies of the adhesive described in the preceding abstract are reduced by the addition of formamide in an amount equal to about 3% of the total dry weight.

Wiley, A. J., Kummer, M. F., Faulkender, C. R., and Van Camp, B., *Tappi* 34: 556–560 (1951); *C.A.* 46: 4225 (1952).

Satisfactory coal briquets can be produced with a binder consisting of 25 to 40% asphalt emulsified with 60 to 75% concentrated waste sulphite liquor. Green compressive strength of the briquets is dependent upon dryness, and is unsatisfactory at H_2O content above 3.9%. Auxiliary heat applied during fluxing reduced the H_2O content to a satisfactory level. Comparisons of economics of asphalt vs. emulsion binder indicate that the latter would be cheaper at locations close to pulp mills.

Ehrensperger, H., U. S. pat. 2,594,302 (April 29, 1952); *C.A.* 46: 6834 (1952).

Waste sulphite liquor is treated with a quaternary ammonium base or salt to form a precipitate which may be used to replace PhOH in PhOH-HCHO type synthetic resins. A quaternary ammonium base or salt includes alkyltrimethyl-, benyldimethylphenyl-, tri(hydroxyethyl) benzyl-, and alkylbenzyldimethylammonium chloride, tetradecylpyridinium bromide, and hexadecyltrimethylammonium bromide. For example, waste sulphite liquor at 180°F. is neutralized with $CaCO_3$, SO_2 is removed in an air stream, the pH is adjusted to 5.8 with $Ca(OH)_2$, the liquor cooled to room temperature, alkylbenzyldimethylammonium chloride added until precipitation is complete, the mixture heated to 150 to 156°F., and the precipitate separated. The product may be treated with a strong mineral acid at room temperature to separate the quaternary ammonium base or salt, which may be recycled.

Egaki, M., Jap. pat. 690 (Feb. 16, 1951); *C.A.* 46: 11684 (1952).

The waste sulphite liquor is neutralized with $Ca(OH)_2$, concentrated, and neutralized with alkali, to form an adhesive for agricultural spraying.

Anon., *Paper Ind.* 32, No. 1: 48 (April, 1950); *Tappi* 33, No. 4: 40A (April, 1950); *B.I.P.C.* 20: 668 (1950).

Several Wisconsin sulphite mills may build torula yeast plants for processing their waste sulphite liquor in the near future; the disposal of the yeast effluent will then become a problem, because it does not respond satisfactorily to the conventional sewage treatment. The Sulphite Pulp Manufacturers' Research League has established a project at the National Resources Research Institute at the University of Wyoming to study the possible commercial use of waste sulphite liquor and yeast effluent as a binder for making briquets from coal dust and for road surfacing. Any results obtained will be made available to all members of the League.

Tanberg, R., U. S. pat. 2,495,148 (Jan. 17, 1950); *B.I.P.C.* 20: 692 (1950).

A process is described for the formation of continuous electrodes for electric furnaces from a mixture of crushed anthracite coal or coke and evaporated waste sulphite liquor (50 to 60% dry solids) as the binding agent; the latter constitutes 10 to 35% of the total electrode composition.

Narayanamurti, D., and Das, N. R., *Indian Forest Leaflet* No. 118: 5 pp. (1949); *B.I.P.C.* 20: 700 (1950).

The materials used in the present study were barks from *Shorea robusta* (sal) and Eucalyptus sp., for which analyses (made by the U. S. Forest Products Laboratory methods) are given. Both barks contain appreciable amounts of "lignin," "cellulose," and pentosans (but the authors point to the limitations of the analytical procedures). At present,

the barks are used as fuel, as a source of tannin, and as insulating material. When the mallet-beaten bark fiber was submitted to steaming at about 40 p.s.i. for 2 hr. and then pressed at 300°F. and 3000 p.s.i. either with or without the addition of waste sulphite liquor and/or various resins, boards (density, 0.87 to 0.97) were obtained which gave satisfactory strength tests. Data on composition, methods of preparation, and properties are given.

Tanberg, R., U. S. pat. 2,508,629 (May 23, 1950); *B.I.P.C.* 20: 767 (1950).

A method is described for the feeding of raw materials to glass-smelting furnaces in the form of continuous belts or bars. Evaporated waste sulphite liquor is incorporated in the continuous bars as a binding agent, and constitutes 10 to 35% of the mass of the agglomerate which is charged into the furnace.

Tanberg, R., Can. pat. 465,260 (May 23, 1950); *B.I.P.C.* 20: 767 (1950). This corresponds to U. S. pat. 2,495,148; cf. *B.I.P.C.* 20: 692 (1950).

Anon., *Paper Trade J.* 134, No. 7: 12 (1952); *Paper Mill News* 75, No. 7: 7 (1952); *B.I.P.C.* 22: 529 (1952).

Experiments are being conducted on the use of waste sulphite liquor as a binder to make sand hold better on slippery road surfaces. The hot sulphite liquor seems to pit the ice surface when it strikes and, if sand is applied immediately, it freezes to the road surface and provides a more lasting grit.

Farber, E., Can. pat. 480,937 (Feb. 5, 1952); *B.I.P.C.* 22: 552 (1952). This corresponds to U. S. pat. 2,574,027; cf. *B.I.P.C.* 22: 305.

Uschmann, C., U. S. pat. 2,585,977 (Feb. 19, 1952); *B.I.P.C.* 22: 642 (1952).

A method of treating waste sulphite liquor to produce a binder for use in the manufacture of wallboard and plywood veneer comprises the steps of heating the liquor to its boiling point and evaporating a substantial portion of the contained water; alkalizing the heated liquor with 5 to 15% (based on the weight of waste liquor) of caustic alkali; adding 15% (based on the weight of alkalized liquor) of furfural to the liquor; and maintaining the resulting liquid at its boiling point for 5 to 30 min.

CHEMICALS

Vanillin

Marshall, H. B., and Sankey, C. A., U. S. pat. 2,544,999 (March 13, 1951); *C.A.* 46: 1042 (1952).

Vanillin can be produced economically and in satisfactory yields as follows: to waste sulphite liquor is added NaOH in an amount equivalent to not less than 75 grams per liter of the liquor, the mixture heated to 175 to 200° with the pressure in the vessel maintained at about 110 p.s.i. and an O-containing gas in finely dispersed form continuously passed through the liquor and the unreacted gas continuously removed, the rate of addition and removal of the gas being such as to maintain a partial pressure of O in the reaction zone of less than 10 p.s.i. The reaction is carried out in the presence of an oxidation catalyst, such as copper sulphate or copper oxide. The reaction time is less than 4 hr. Several examples discuss the process in detail, and a diagram of the apparatus is given; cf. *C.A.* 44: 9674 (1950). Corresponds to Can. pat. 482,191 (April 1, 1952); *B.I.P.C.* 22: 720 (1952).

Fisher, J. H., and Marshall, H. B., U. S. pat. 2,576,752-3 (Nov. 27, 1951); *C.A.* 46: 2803 (1952).

An alcohol plant effluent containing lignin is mixed with sufficient slaked lime to keep the pH above 12 and heated under pressure with a constant supply of air. The yield of vanillin is 4.8% on a lignin basis. Dilution of the waste sulphite liquor to contain 10 to 38 grams of lignin and lengthening the reaction time increases the yield of vanillin; cf. *C.A.* 46: 1042 (1952). Corresponds to Can. pat. 483,827-3 (June 3, 1952).

Fisher, J. H., and Sankey, C. A., U. S. pat. 2,576,754 (Nov. 27, 1951); *C.A.* 46: 2803 (1952).

Vanillin is produced in a continuous process from alcohol plant effluent by oxidation of lignin in the presence of lime and air by heating under pressure. Corresponds to Can. pat. 483,829 (June 3, 1952).

Kratzl, K., and Keller, I., *Monatsh.* 83: 205–209 (1952); *C.A.* 46: 5837 (1952).

Three carbohydrate-free lignin preparations (Brauns native spruce lignin, Freudenberg's cuproxam beech lignin and Willstätter spruce lignin) were sulphonated with soda base liquor in 99, 77, and 94% yields, respectively. The ligninsulphonic acids thus prepared were hydrolyzed first with 3.8% NaOH and then with 19.4% NaOH, and the AcH and vanillin were determined. Yields of 1.32 to 1.83% AcH and 2.43 to 4.77% vanillin indicated that the "masking" of alkali-cleavable groups is inherent in the lignin mol.

Pearl, I. A., Swed. pat. 123,751 (Jan. 11, 1949); *C.A.* 46: 5843 (1952).

Vanillic acid is separated from lignin oxidation mixtures in the form of a lower alkyl ester by isolating an acid-containing fraction, esterifying with a lower alkyl alcohol, and separating the ester by distillation. Thus the mixture obtained by the alkaline Ag_2O oxidation of Ca ligninsulphonate is acidified with H_2SO_4 and extracted with Et_2O. The Et_2O is extracted with 21% $NaHSO_3$ and then with saturated $NaHCO_3$. The $NaHCO_3$ solution is acidified with H_2SO_4 and extracted with Et_2O. The Et_2O is removed, and the residue esterified with 25 parts EtOH and 1.5 parts concentrated H_2SO_4. The excess EtOH is removed and the solution neutralized with $NaHCO_3$ solution and extracted with Et_2O. The Et_2O is removed and the residue fractionated under reduced pressure to yield pure ethyl vanillate. Modifications of the process are discussed; cf. *C.A.* 44: 1706 (1950).

Leopold, B., *Acta Chem. Scand.* 6: 55–63 (1952); cf. *C.A.* 46: 2799 (1952); 46: 7765 (1952).

Low sulphonated lignin prepared according to the method of Erdtman (*C.A.* 39: 2196) was heated in sulphite solutions of various pH and with alkali for different times, and in acid solution alone or in the presence of resorcinol. The products were analyzed and oxidized with $PhNO_2$ and alkali. A solution of the Ba salt of low sulphonated lignin was passed through Amberlite IR 120, the effluent neutralized with NaOH, SO_2 corresponding to 6% of the final amount of solution absorbed, the solution divided into samples containing 4 grams of the ligninsulphonic acid salt, NaOH added to give the desired pH, and the volumes adjusted to 75 ml. The samples were heated at 135° for various times, cooled, freed from excess SO_2 by a stream of CO_2, the Na ions exchanged for H ions, the solution neutralized with $BaCO_3$, filtered, evaporated *in vacuo* to 35 ml., centrifuged, the solution poured into 150 ml. absolute EtOH, and the precipitate centrifuged, and washed twice with EtOH and three times with Et_2O. The acid solutions were prepared by adding dilute sulphuric acid to a solution containing the sulphonic acid and 1.4% NaOH to the desired pH, and samples corresponding to 4 grams of sulphonic acid were diluted to 75 ml., and 4 grams resorcinol added if desired. The alkaline solutions containing no sulphite were prepared in the same way as the corresponding sulphite solutions, sulphuric acid being added to pH 11.4. In the experiments with wood, 5 grams extracted *Picea abies* was heated with 40 ml. of the acid solution described above, the amount of resorcinol used being 0.3 gram per gram wood.

The undissolved residues were separated, washed with water and Me_2CO, and dried 4 hr. at 105°. Most of the reactive groups in low sulphonated lignin could be sulphonated at low rate in almost neutral media. The yield of vanillin was not affected by sulphonation. Alkaline treatment of low sulphonated lignin caused deep-seated changes in structure, even in the presence of sulphite, but the total yield of vanillin was relatively constant. Sulphonation rendered the lignin more stable to condensing agents. The major part of the sulphonated groups in low sulphonated lignin probably belongs to "condensed elements," or possibly elements of the pinoresinol type, while the remainder of the groups belong largely to elements of the open type, of which at least 25% are relatively stable to acids and reactive phenols.

SCHOEFFEL, E. W., U. S. pat. 2,598,311 (May 27, 1952); *C.A.* 46: 7770 (1952).

Waste sulphite liquor (from a pulping process) containing 3.5% lignin and 10% NaOH is treated with O (compressed air) at about 200° and about 1500 p.s.i. to convert about 21% of the lignin to vanillin, of which about 80% is recovered; cf. *C.A.* 42: 2403.

PEARL, I. A., U. S. pat. 2,602,089 (July 1, 1952); *C.A.* 46: 9309 (1952).

Guaiacyl compounds are prepared in high yield by the treatment of gymnosperm lignin at 160 to 180° with NaOH and KOH in the presence of CuO. Ca ligninsulphonate containing 144 grams gymnosperm lignin from spruce wood, 360 grams NaOH, 862 grams hydrated CuO, and 5 liters H_2O is heated to 180° over 1 hr. and held for 1 hr. at 180°, cooled, and the clear liquor is separated from the CuO sludge, which is washed free of soluble lignin material. The combined liquors are acidified with H_2SO_4 and extracted with Et_2O, and the Et_2O extract, containing guaiacyl compounds in 55% yield, is fractionated into $NaHSO_3$, $NaHCO_3$, and NaOH-soluble fractions. The highest yield of guaiacyl compounds is obtained at a molecular ratio of CuO to unit molecular weight of lignin of 9.5:1 to 16.7:1. Guaiacyl compounds consist chiefly of vanillin, 5-carboxyvanillin acid, 5-carboxyvanillic acid, guaiacol, acetovanillone, bisdehydrovanillin, and bisdehydrovanillic acid; cf. *C.A.* 42: 1608.

STRAND, D. E., *Nature* 164, No. 4182: 1093 (1949); *B.I.P.C.* 21: 391 (1950).

Vanillin and syringaldehyde were separated by paper partition chromatography using petroleum ether saturated with water as the mobile phase. After fractionation, the papers were developed by spraying with 0.4% 2,4-dinitrophenylhydrazine in 2 *N* hydrochloric acid. The method was used in examining aldehyde mixtures obtained on oxidation of *Eucalyptus resinifera* Sm. and *Eucalyptus diversicolor* F.v.M. with nitrobenzene and alkali.

WILVESEN, J. R., DIDDAMS, D. G., BRINK, D. L., and OWERSKI, P., Can. pat. 478,555 (Nov. 13, 1951); *B.I.P.C.* 22: 1113 (1952).

As an example, a liquor which contains 231 grams per liter of basic calcium lignin sulphonate and 105 grams per liter of sodium hydroxide is cooked at 160°C. for 70 min.; during this period air is introduced into the reaction mixture in sufficient amounts so that 32 grams of oxygen are consumed by each 100 grams of lignin present. The increase in vanillin yield from this cook over that obtained by cooking the same liquor under optimum conditions for maximum vanillin yield without the introduction of oxygen is 82%. This is the same as U. S. pat. 2,434,626; cf. *B.I.P.C.* 18: 419–420.

PEARL, I. A., U. S. pat. 2,431,419 (Nov. 25, 1947); *B.I.P.C.* 21: 554 (1952).

A method for the purification of a vanillic acid-containing acid fraction obtained by the degradation of a lignin substance (e.g., acid or alkaline process waste liquor) comprises the removal of impurities by precipitation with neutral lead acetate, filtration, treatment of the filtrate with hydrogen sulphide, removal of the resulting lead sulphide precipitate from the filtrate, and recovery of vanillic acid from the filtrate.

KRATZL, K., and KVASNICKA, E., *Monatsh.* 83, No. 1: 18–23 (Feb. 15, 1952); *B.I.P.C.* 22: 616 (1952).

The authors have prepared several amides of vanillic acid, their acetyl and carbethoxy derivatives, and a few of its related acids as a start in their studies on the derivatives of vanillin with pharmacological properties. Acetyl or carbethoxy acid chlorides were condensed with the appropriate amine to give the amide. Phenolic acid amides were obtained by partially hydrolyzing the acetyl or carbethoxy groups with sodium hydroxide.

PEARL, I. A., and BARTON, J. S., *J. Am. Chem. Soc.* 74, No. 5: 1357 (March 5, 1952); cf. *B.I.P.C.* 22: 141; 22: 616 (1952).

Vanillin was treated with sodium chlorite in the presence of acetic acid at pH 3 at 45°C. for 8 hr. The ether-soluble fraction of the reaction mixture was separated into bisulphite-, bicarbonate-, and alkali-soluble fractions and neutral material. The bisulphite-soluble fraction yielded crystals of 2,4-furanedicarboxylic acid, the preparation of which has been reported previously by treating methyl coumalate with potassium hydroxide.

PEARL, I. A., and BEYER, D. L., *Anal. Chem.* 24, No. 8: 1366 (1952); cf. *B.I.P.C.* 22: 499–500; 23: 54 (1952).

A simple chromatographic procedure for the quantitative separation of vanillic and protocatechuic acids is reported. The procedure is the same as that employed earlier for the separation of vanillin and syringaldehyde (cf. *B.I.P.C.* 21: 500), except that the developer used in the present case is 20 to 1 benzene-ethanol. The acids were separated by this developer on a column of acid-washed Magnesol (which had been left standing overnight in open pans) and located by a ferric chloride streak; this produced a blue-green color with the protocatechuic acid band and a reddish-brown color with the vanillic acid band.

CHEMICAL WEEK, *Chem. Week* 71, No. 11: 55–56 (Sept. 13, 1952); *B.I.P.C.* 23: 131 (1952).

Reference is made to expanded production of vanillin from waste sulphite liquor by Monsanto and Ontario Paper Co. in the United States and Canada, respectively, which will end a decade-long shortage of the material. The eugenol and guaiacol processes are gradually being replaced, as more producers switch to the use of waste sulphite liquor. Some of the big producers are searching for possible new markets (chemical intermediates, fungicides, insecticides etc.) so that, in the future, vanillin may become an important chemical raw material as well as a flavoring agent.

ANON., *Can. Chem. Processing* 36, No. 11: 58, 60 (Oct., 1952); *B.I.P.C.* 23: 207 (1952).

The new process for making vanillin from waste sulphite liquor at the Thorold, Ont., mill of the Ontario Paper Co. is described. The process is based on the use of lime in place of the more expensive caustic soda and was developed by Fisher, Marshall, and Sankey (cf. U. S. pats. 2,576,752–4 (Nov. 27, 1951); *B.I.P.C.* 22: 386).

Other Phenolic Compounds

LACKEY, H. B., U. S. pat. 2,577,470 (Dec. 4, 1951); *C.A.* 46: 6155 (1952).

Conidendrin was separated from waste sulphite liquor by extracting waste sulphite liquor with an organic solvent char-

acterized by insolubility in waste sulphite liquor and the ability to separate conidendrin from waste sulphite liquor as a solid deposit, and separating the solid conindendrin from the mixture of waste sulphite liquor and organic solvent. Organic solvent may consist of a halogenated hydrocarbon ($CHCl_3$), ether (Et_2O), ketone, or aldehyde (furfural), liquid ester (AcOEt), or fatty acid (oleic acid); e.g., 151.5 liters waste sulphite liquor at 25° was stirred rapidly 30 min. with 3 liters CCl_2:CHCl (the preferred solvent), and the mixture let stand 16 hr., with formation of three layers: a top layer of waste sulphite liquor, an intermediate layer of solid conindendrin, and a bottom layer of CCl_2:CHCl. Most of the conidendrin layer was removed by siphoning and the solid conidendrin by filtration. The yield of conidendrin, m. 251–253°, was 1.28 grams per liter compared with 1.4 grams per liter obtained by the continuous extraction of conidendrin 8 hr. with $^1/_4$ its volume of CCl_2:CHCl at the boiling point.

Pearl, I. A., and Beyer, D. L., *J. Am. Chem. Soc.* 72, No. 4: 1743–1746 (1950); cf. *B.I.P.C.* 19: 878; 20: 671 (1950).

A number of esters of syringic and protocatechuic acids have been prepared and tested for their toxicities toward representative microorganisms; the results are tabulated. The protocatechuic acids were more effective in low concentrations than the syringates. The ultraviolet absorption spectra of both types of esters were also determined.

Marathon Corp., *Chem. Processing* 14, No. 1: 18 (Jan., 1951); cf. *B.I.P.C.* 21: 319; 21: 401 (1951).

Acetovanillone is obtained by solvent extraction, distillation, and recrystallization of alkaline degradation products of lignin and is now available in pilot plant quantities as a product of 98 to 99.5% purity. Its utilization in the synthesis of various chemical substances is suggested. The characteristic reactions of acetovanillone are presented in tabular form.

Pearl, I. A., Can. pat. 476,928 (Sept. 11, 1951); *B.I.P.C.* 22: 229 (1951).

Vanillic acid is prepared by the subjection of calcium ligninsulphonate at a temperature of at least 50°C. to the oxidizing action of silver oxide in the presence of an aqueous sodium hydroxide solution, acidification of the reaction mixture, extraction of the acidified mixture with a water-immiscible vanillic acid solvent (e.g., ether), and recovery of vanillic acid from the extract. This is the same as U. S. pat. 2,483,559; cf. *B.I.P.C.* 20: 225.

Pearl, I. A., and Dickey, E. E., *J. Am. Chem. Soc.* 74, No. 3: 614–617 (1952); cf. *B.I.P.C.* 21: 272–273; *B.I.P.C.* 22: 499 (1952).

Because the complex nature of fractions obtained by oxidizing ligninsulphonate materials with cupric oxide and alkali precluded their complete analysis by previously employed procedures, recourse was made to adsorption chromatography. By means of this technique, the sodium bisulphite and alkali-soluble fractions from such oxidations have yielded, in addition to previously isolated compounds, the following new oxidation products: 4,4′-dihydroxy-3,3′-dimethoxychalcone, 4,4′-dihydroxy-3,3′-dimethoxybenzil, 4,4′-dihydroxy-3,3′-dimethoxybenzophenone, and an unidentified isomer of dehydrodivanillin which is probably a dihydroxydimethoxyformylbenzophenone. Although the isolation of these products can be explained by assuming their resynthesis from vanillin or the like originally formed by degradation of the lignin, there is also a possibility that some of the C_6-C_3 units in the lignin structure are linked together through the α-carbon atoms.

Pearl, I. A., U. S. pat. 2,602,089 (July 1, 1952); *B.I.P.C.* 22: 972 (1952).

Guaiacyl compounds are prepared in high yield from a gymnosperm lignin (e.g., from sugar-free fermented waste sulphite liquor) by the digestion of the lignin substance in an aqueous mixture under pressure at 160 to 180°C. in the presence of cupric oxide and an excess of sodium hydroxide. The molecular-weight ratio of cupric oxide to lignin is about 13:1.

Grangaard, D. H., Can. pat. 485,511 (Aug. 5, 1952); *B.I.P.C.* 23: 75 (1952).

This corresponds to U. S. pat. 2,488,186 (Nov. 15, 1949); cf. *B.I.P.C.* 20: 294–295.

Sulphite Turpentine

Smirnow, A., *Przeglad Papier* 7: 7–12 (1951); *C.A.* 46: 73[illegible] (1952).

A review of *p*-cymene, by-product of the pulp industry.

Kleinert, Th., *Monatsh.* 83: 1009–1010 (1952); *B.I.P.C.* 23: 245 (1952).

The formation of *p*-cymene in the sulphite cooking process is caused by a dehydrogenation of terpenes whereby the lignin acts as a hydrogen acceptor. The dehydrogenation is favored by the hydrogen ions of the cooking liquor.

Furfural

Ogait, A., *Das Papier* 6: 7–9 (1952); *C.A.* 46: 4792 (1952).

Waste sulphite liquors from beechwood (which originally contains 20 to 22% pentosans) is considered as a possible source of furfural, whereas those from spruce are not. Recovery procedures were similar to those used in the case of agricultural wastes, but the steam consumption in the case of waste sulphite liquors was much greater. Yields of furfural per ton of pulp from waste sulphite liquor were about 50 kg.; another 5 to 10 kg. furfural could be obtained from the condensates of relief gases. At present furfural from waste sulphite liquor cannot compete with that from agricultural wastes.

Inorganic Compounds

Nilsson, N. E., Swed. pat. 133,379 (Oct. 23, 1951); *C.A.* 46: 5318 (1952).

Apparatus for the recovery of the inorganic constituents of waste liquors, particularly from cellulose pulp digesters.

Schwabe, K., *Wochbl. Papierfabrik* 77: 417–419, 475–478 (1949); 78: 119–123 (1950); *Chem. Zentr.* 1950, I: 2301; II: 1526; *C.A.* 46: 11680 (1952).

See *C.A.* 43: 3196 (1949). The recovery of sulphur from waste sulphite liquors.

Lochman, C. J., U. S. pat. 2,494,098 (Jan. 10, 1950); *B.I.P.C.* 20: 462 (1950).

A system for the recovery of heat and sulphur dioxide from relief gases and waste sulphite liquor comprises the continuous relief of the digester during the discharge of waste liquor, the passage of the relief gases, and the flash vapour from the liquor to a common chamber, and the transfer of the resulting mixture to a heat-exchange system.

Dean, D. K., *Tappi* 33, No. 4: 195–201 (1950); *B.I.P.C.* 20: 672 (1950).

The possibilities of recovering heat from various pulp and paper mill operations and the necessary equipment are discussed. Four types of blowdown recovery systems are outlined. In the sulphite process sulphur dioxide can also be reclaimed. Appreciable amounts of heat can be obtained from digester relief, in deinking plants, and from the paper-machine room. The application of the steam accumulator is considered.

Logan, K. C., and Purves, C. B., *Tappi* 35, No. 6: 284–288 (June 1952); *B.I.P.C.* 22: 857 (1952).

Although the neutral sulphite process for pulping woods has many merits, a practical method of recovering the expensive sodium base is not yet available. The present article deals with laboratory-scale experiments in which over 90% of the sodium was recovered, as nearly pure caustic soda of up to 2% concentration, by electrolyzing the waste liquor in a cell with a porous clay diaphragm, and a nickel cathode. Electrical efficiencies ranged up to 70% in a four-stage electrolysis, and the average value of 55% corresponded to the consumption of about 2.2 kw.-hr. per lb. of caustic soda recovered. The oxidation of purified, carbohydrate-free sodium ligninsulphonate was studied under strongly alkaline conditions in a cell with a copper anode and no diaphragm. Part of the sulphonic acid group was released as sulphuric acid; oxalic acid dihydrate up to 16% by weight was the only other acid identified. The production of the dihydrate required about 13.4 kw.-hr. per lb. The economic implications of the above results are discussed briefly.

OSTEN, M. M., Can. pat. 485,389 (Aug. 5, 1952); *B.I.P.C.* 3: 76 (1952).

A conventional distillation column is provided with an additional length of column in which degasification is effected by the flow of heat and vapour from the distillation column below. The gas is removed from the top of the additional column.

ANNBRO, N. V., U. S. pat. 2,611,682 (Sept. 23, 1952); *B.I.P.C.* 23: 154 (1952).

Hydrogen sulphide is recovered from the smelt containing sodium sulphide and sodium carbonate by passing a solution of the smelt and carbon dioxide-containing gas in counterflow through an absorption tower. The gas rate is so adjusted that practically all the carbon dioxide introduced is absorbed in the tower but no hydrogen sulphide is expelled; the hydrogen sulphide present in the soda liquor removed from the bottom of the tower may be recovered by introducing the liquor into a vacuum chamber. The process is applicable to waste liquors from the semichemical process, to black liquor which has been freed of lignin by sulphur dioxide, and to waste sulphite liquor which has been used in the sulphate process.

EMULSIFYING AND DISPERSING AGENTS

LVESEN, J. R., and HARMON, C., U. S. pat. 2,576,418 (Nov. 1951). See also Can. pat. 487,085 (Oct. 7, 1952); *C.A.* 1257 (1952).

New and useful lignin compounds are obtained by subjecting ligninsulphonates to critically controlled alkaline hydrolyzing conditions. The starting material is Na ligninsulphonate (prepared from calcium ligninsulphonate according to the methods described in U. S. pat. reissue 18,268 (*C.A.* 26: 1122); U. S. pat. 2,104,701 (*C.A.* 32: 1720); U. S. pat. 2,371,136 (*C.A.* 39: 3160), or by other methods) in concentrations of 250–350 grams per liter. Sufficient NaOH is added so that the mixture contains 8 to 25 grams per liter free NaOH prior to digestion. The solution mixture is heated under autogenic pressure or higher at 200 to 255° for 20 to 120 min. The remaining free NaOH is neutralized with H_2SO_4 or CO_2 to a pH value of about 10.5, after which the solution may be utilized directly or it may be dried to a powder by conventional means. The product is H_2O soluble, at pH 10.5 or higher, to the extent of at least 95% by weight. It strongly absorbs O, and its aqueous alkaline solution is an effective dispersing agent for clay or other inorganic suspensions. It has valuable properties as a component in water-water treatment and presents a useful starting material for the preparation of pure organic degradation products from lignin sulphonates.

IPTURE, E. W., JR., *Paper Trade J.* 129, No. 17: 33–37 (49); *B.I.P.C.* 20: 207 (1949).

Calcium ligninsulphonate derived from waste sulphite liquor is a specific dispersing agent for cement. Studies have been made of various physico-chemical properties of this compound in view of the influences these might have on cement dispersion. Purity is of importance, as the sugar content of normal liquor adversely affects cement hydration. An almost ideal composition is secured in the fermentation process for the production of alcohol from waste sulphite liquor. Data are presented to show the improvements in such concrete properties as workability, strength, watertightness, and durability through the use of calcium ligninsulphonate.

BARNES, W. E., U. S. pat. 2,491,436 (Dec. 13, 1949); *B.I.P.C.* 20: 376 (1950).

An aqueous drilling mud comprises calcium bentonite dissolved in water and 1 to 10 lb. per barrel of calcium ligninsulphonate as a viscosity reducing material.

PERKINS, H. W., U. S. pat. 2,491,437 (Dec. 13, 1949); *B.I.P.C.* 20: 376 (1950).

An aqueous drilling mud comprises a hydratable alkaline earth-metal clay (e.g., calcium bentonite), 1 to 10 lb. per barrel of calcium ligninsulphonate, and 0.75 to 3 lb. per barrel of quebracho. Quebracho prevents excessive increase in viscosity and gelation when the drilling mud is permitted to stand quiescent under well conditions.

MACPHERSON, D. R., FRANCE, W. G., and ERNSBERGER, F. M., U. S. pat. 2,485,102 (Oct. 18, 1949); *B.I.P.C.* 20: 462 (1950).

A hydraulic cement composition incorporates the dialyzed lignin residuum solids retained by the dialyzing membrane in the dialysis of waste sulphite liquor which has not been preconcentrated (i.e., the specific gravity of the liquor is less than 1.1) and which has not been neutralized prior to dialysis.

STEWART, W. D., U. S. pat. 2,470,115 (May 17, 1949); *B.I.P.C.* 20: 462 (1950).

A stable dispersion of polyethylene polysulphide particles (not larger than 1 to 3 μ in diameter) in an aqueous medium is obtained by preparing an aqueous reaction mixture of ethylene dichloride, sodium polysulphide, and a lignin sulphonate, and agitating the mixture at 20 to 60° C. The dispersion is suitable for coating and impregnating paper, textiles, leather, and the like.

JESSEPH, D. C., U. S. pat. 2,494,708 (Jan. 17, 1950); *B.I.P.C.* 20: 768 (1950).

An emulsion of water and a bituminous material, in which water is the continuous phase and the bitumen is the disperse phase, is stabilized by the addition of 2 to 6% of ammonium ligninsulphonate. The emulsion is used in road construction and soil stabilization.

MACPHERSON, D. R., Can. pat. 465,873 (June 13, 1950); *B.I.P.C.* 20: 841 (1950).

This is the same as U. S. pat. 2,435,594; cf. *B.I.P.C.* 18: 491.

BIRD, P. G., U. S. pat. 2,576,386 (Nov. 27, 1951); *B.I.P.C.* 22: 383 (1952).

Scale formation is prevented in steam generators by the incorporation in the boiler feedwater of a scale-inhibiting, water-soluble substance which results from the alkaline hydrolysis of sodium ligninsulphonate with caustic soda at 200 to 225° C. for 20 to 120 min. under superatmospheric pressures sufficient to maintain the liquid phase. The corresponding Canadian pat. is 484,359 (June 24, 1952); *B.I.P.C.* 22: 972 (1952).

SALATHIEL, R. A., U. S. pat. 2,582,459 (Jan. 15, 1952); *B.I.P.C.* 22: 472 (1952).

A composition which is suitable for use in the cementing

of oil wells consists of Portland cement, 16% by weight of colloidal clay (e.g., bentonite), 0.5% by weight of calcium ligninsulphonate, both based on the dry cement, and approximately 10 gal. of water for each 94 lb. of cement.

Bird, P. G., U. S. pat. 2,505,457 (April 25, 1950); Can. pat. 482,689 (April 22, 1952); *B.I.P.C.* 22: 798 (1952).

A method of inhibiting phosphate boler scale involves the incorporation in the boiler feedwater of a composition which is soluble in alkaline solution at a pH of 10.5 and which results from the alkaline hydrolysis of sodium ligninsulphonate (e.g., from waste sulphite liquor) with caustic soda at 265 to 325°C. for 30 to 120 min. under superatmospheric pressure.

Adams, J. W., Messer, W. E., and Howland, L. H., *Ind. Eng. Chem.* 43, No. 3: 754–765, 1951; *B.I.P.C.* 22: 912 (1952).

In a thorough investigation of processes for producing master batches from improved butadiene-styrene copolymers and fine furnace blacks, carbon black dispersions in master batch compounds, and appropriate dispersing agents (including lignin and bark compounds) were studied. A table is included in which the required percentage of a number of dispersing agents is listed for producing fluid 20% HAF (a high-abrasion furnace carbon black supplied by Phillips Petroleum Co., Akron, Ohio) black slurries. Well-dispersed slurries could be prepared by treating proper mixtures of carbon black, dispersing agent, and sodium hydroxide for at least 90 sec. in a Waring blendor. Both the dispersing agent and sodium hydroxide concentrations affected the particle size of the dispersed black. The amounts of dispersing agent necessary to produce fluid slurries were considerably less than the amount required to obtain minimum particle sizes of the dispersed blacks. The best results were obtained with Marasperse CB, other dispersing agents used were Silvacon 490, western hemlock bark extract, Indulin A and C, chestnut extract, Tomlinite, ammonia-base sulphite liquor, redwood-bark dust extract, and bark 49 to 126 extract. When up to 3.0% of lignin or ligninsulphonic types of dispersing agents was used for preparing the slurries, little trouble was encountered in obtaining rapid and complete deflocculation.

Salvesen, J. R., Browning, W. C., and Harmon, C., Can. pat. 487,084 (Oct. 7, 1952); *B.I.P.C.* 23: 302 (1952).

This corresponds to U. S. pat. 2,491,832 (Dec. 20, 1949); cf. *B.I.P.C.* 20: 376 to 377. Waste sulphite liquor or basic calcium ligninsulphonate is heated under pressure with sodium hydroxide at 140 to 170° and treated with air. The product is suitable for dispersing carbon black, clay, or zinc oxide.

FERMENTATION

Bolz, F., and Gade. M., Ger. pat. 805,153 (May 7, 1951); *C.A.* 46: 218 (1952).

Potable EtOH is produced from sulphite waste- or wood sugar-alcohol by chemical purification in a continuous distillation system. AcH, fusel oils, and terpenes are treated and removed with alkali. MeOH is removed by azeotropic distillation with small quantities of trichloroethylene.

Wurz, O., *Das Papier* 5: 578–581 (1951); *C.A.* 46: 255 (1952).

An address dealing with the composition of sulphite alcohol, its physical utilization, and its conversion into $(CH_2OH)_2$ and its derivatives, AcOH, BuOH, etc.

McGinn, E. P., *Paper Trade J.* 133, No. 10: 96, 98–100 (1951); *C.A.* 46: 681 (1952).

A general description of the process and equipment for manufacture of yeast from sulphite liquor.

Murphy, D., and Stranks, D. W., *Can. J. Technol.* 29: 413–420 (1951); *C.A.* 46: 1255 (1952).

Three samples of waste sulphite liquor, containing 2.6 to 4.28% of copper reducing substances, were boiled and aerated for 15 min. to remove the sulphur dioxide and then cooled. Nutrients were added (0.1% $NH_4H_2PO_4$ and 5 ml. 10% molasses per 100 ml. medium) and the pH was adjusted to 8.5 with NH_4OH. The medium was then autoclaved at 15 p.s.i. for 10 min., causing the pH to fall to 6.0. The cultures were grown on 5% molasses with 0.5% cornsteep liquor for 20 hr.; 5 to 10 ml. of culture was added to 100 ml. of waste sulphite liquor medium. The still cultures were shaken for 1 min. every 12 hr. The shake cultures were shaken continuously at 100 r.p.m. The temperature of incubation was 35°. The organisms used were *Bacillus polymyxa, Aerobacter aerogenes, Bacillus subtilis, Serratia,* and *Pseudomonas hydrophila.* In shake cultures it was necessary to add $CaCO_3$ to control the pH during fermentation. *Aerobacter aerogenes, Serratia* and *Pseudomonas hydrophila* gave good yields of 2,3-butanediol and EtOH, *Bacillus polymyxa* was less satisfactory, and *Bacillus subtilis* grew only when sugar-beet molasses was added. Good yields were obtained when the waste sulphite liquor was concentrated to half its volume or when the sugar content was doubled by means of sugar-beet molasses. Shake cultures gave faster fermentations than still cultures. It was concluded that, for each sample of waste sulphite liquor, it will be necessary to determine the optimum concentration, pH, and organism.

Roschier, H., and Aaltio, E., *Paper and Timber (Finland)* 32B: 189–194 (1950); *C.A.* 46: 2800 (1952).

Total hexoses in the waste sulphite liquor from experimental aspen and birch pulps were determined by fermentation. Galactose was determined by difference from total hexoses after fermentation with molasses yeast, which does not ferment galactose. Mannose and glucose were determined on the basis of the sugar-bisulphite dissociation constants by the method of Jacobus Sundman (cf. *C.A.* 44: 861). Pentoses were determined in a sample from which hexoses had been removed by fermentation. One aliquot was fermented with Hansenula suaveolens which ferments xylose only, and another with *Candida guilliermondii* which ferments both xylose and arabinose (Wise and Appling, *C.A.* 38: 700; Auerheimer and Wickerham, *C.A.* 42: 8711). Calculated to a dry wood basis the birch (aspen) waste liquors were thus found to contain: mannose 2.9 (1.3), glucose 0.5 (0.2), galactose 0.3 (trace), xylose 9.7 (10.3), arabinose 0.0 (1.6), uronic acids 0.7 (0.5), and unknown reducing substance 2.1% (0.6%).

Sundman, J., and Sundman, V., *Paper and Timber (Finland)* 32B: 379–383 (1950); *Brit. Abstracts* 1951B, III: 306; cf. *C.A.* 44: 4193 (1950); 46: 3211 (1952).

Aldehyde formation and alcohol yield in the fermentation of waste sulphite liquor.

Murphy, D., *Can. J. Technol.* 29: 471–478 (1951); *C.A.* 46: 3211 (1952).

In the presence of $MgSO_3$, samples of commercial yeast were grown on treated waste sulphite liquor. After approximately 67 hr. fermentation, the yields of glycerol were small, ranging from 0.03 to 0.36 gram per 100 ml. of medium.

Katagiri, H., Tatsumi, C., and Fujii, Y., *Bull. Inst. Chem. Research, Kyoto Univ.* 27: 74 (1951); cf. *C.A.* 45: 4875; *C.A.* 46: 4167 (1952).

Availability of the waste liquor from factories for manufacturing fodder yeast was studied with *Torulopsis xylinus,* a, b, and c. Expressed juice of sweet potato was adjusted to pH 4.5 with HCl, kept 1 hr. at 70°, and filtered. The solution contained 5.5 grams sugars and 0.15 gram N per 100 ml. The diluted solution containing 2.5 grams sugar per

00 ml. was cultured with the yeasts. The sugar consumption exceeded 85% and the crop yield of yeast was about 5% of the amount of sugar consumed. Addition of inorganic salts or malt extract produced no marked effect. The east contained ash 7.38, crude protein 49.10, crude fat, .50%, and vitamin B_1, 15.7%; it was similar to the yeast btained on ordinary medium. A sulphite-pulp waste quor was aerated to remove free SO_2 (1.98 grams per liter) nd neutralized with $Ca(OH)_2$. The solution contained 3.06 grams organic matter, 3.23 grams sugar (as glucose), 012 gram N, and 0.99 gram free SO_2 per 100 ml. The diited solution was cultured with the yeasts. Addition of a source was necessary for the fermentation; $(NH_4)_2SO_4$, ie expressed juice of sweet potato, and rice bran extract ere found to be suitable. The maximum sugar consumpon, 51.14%, was attained with *T. xylinus* c in 24 hrs. inbation; crop yield was 37.54%. The chemical composion of the yeasts obtained indicated that they are useful for dder.

HIERFELDER, K., Ger. pat. 805,347 (May 17, 1951); *C.A.* 5: 4796 (1952).

The free SO_2 and part of the bound SO_2 are converted by ddition of Cl (2 to 3 kg. per cu. m.) to H_2SO_4, this increases e fermentability of the sulphite liquor and subsequent yields EtOH.

IHARA, Y., SATO, T., and YAMAGUCHI, T., *J. Agr. Chem. c. Japan* 22: 45–46 (1948); *C.A.* 46: 5784 (1952).

Waste sulphite liquor (total N 0.0156, reducing sugar 40, free SO_2 0.224%) was neutralized to pH 7.0 with Ca-$H)_2$, heated at 100° for 30 min., and diluted to sugar conntration of about 1%. Ninety-three per cent of the sugar s fermentable with distillery yeast. Additional nutrients cessary were rice bran (at least 0.3%) and $(NH_4)_2SO_4$ (at st 0.06%) to be added simultaneously. *Mycotorula jaonica* was better than *Torula utilis* in sugar-consuming ratio .58, 66.41%, resp.) and yeast yield (31.04, 24.017% for al sugar, resp.). The yeast yield could be increased to .5% when 0.5% rice bran and 0.1% $(NH_4)_2SO_4$ were added supplementary nutrients. Peat hydrolyzate could be used tead of rice bran.

NNINK, H. F., and MULLER, F. M., Antonie van Leeuenhoek, *J. Microbiol. Serol.* 18: 45–54 (1952); *C.A.* 46: 39 (1952).

About 20% of the total sulphur in monosulphite waste uor can be converted to H_2S by sulphate-reducing bacteria. S is removed by treatment with Fe oxide hydrate. CH_4 mentations can now develop in the treated waste liquor.

ERING, H., *Das Papier* 6: 122–125 (1952); *C.A.* 46: 59 (1952).

Various methods for determining fermentable sugars in ste liquor are described. A simple modification of Doer-r's method (*C.A.* 45: 1342 (1951)) is discussed. Standard OH in a wide-mouth Erlenmeyer flask is placed in a heavy mentation vessel which holds 100 ml. of waste liquor. e fermentation is then carried out after evacuating the sel. The CO_2 is absorbed by the alkali and is determined differential titration after a suitable time period. The overy of CO_2 from solutions of pure D-glucose ranged from 1 to 96.3% of the calculated amount.

MAGUCHI, T., *J. Japan. Tech. Assoc. Pulp Paper Ind.* 6: –194 (1952); *C.A.* 46: 9248 (1952).

Comparative studies were made in laboratory experiments the growth rate, time, and properties of the product from *cotorula japonica* and seven other strains of pentose-izing yeasts. This was followed by pilot-plant tests th the Waldhof fermenter) on aeration rate and yields, st d. and fermentation time, pH, feeding rate, and sources of N. The eight strains had about the same activity. It was necessary to use an antifoaming agent. Careful control of liquor feed is necessary for continuous fermentation.

GADD, G. O., *Finnish Paper Timber J.* 28, No. 7 A: 61–67 (April, 1946); *B.I.P.C.* 20: 46 (1949).

During the fermentation of waste sulphite liquor, difficulties may be encountered because of the presence of certain chemical compounds, notably directly titratable sulphur dioxide, acetaldehyde, and furfural. The inhibiting action of these three compounds was investigated and the following chief conclusions were drawn from the results: sulphur dioxide has a different effect on commercial yeast than that obtained from waste sulphite liquor. In the first case, as little as 0.01% may cause a decrease in the percentage of fermented sugar (measured after a fermentation period of 24 hr.), whereas the sulphite alcohol yeast will stand the presence of 0.02 to 0.03%, indicating that it has become partially acclimatized to sulphur dioxide. When acetaldehyde is present in quantities greater than 0.15%, fermentation is retarded. The inhibiting effects of small quantities of sulphur dioxide are neutralized by acetaldehyde because of its known property of reacting with bisulphite. If the loss in aldehyde caused by this reaction is replaced, the alcohol yield rises. Furfural, which occurs regularly in the waste liquors from dissolving pulps, may have an inhibiting effect on fermentation; part of furfural is reduced by yeast. Sulphur dioxide is not completely bound by equivalent quantities of furfural.

SUNDMAN, J., *Paper and Timber* (*Finland*) 32, No. 9: 267–274 (Sept., 1950); *B.I.P.C.* 21: 194 (1950).

A significant part of certain of the polysaccharides originally present in the wood is hydrolyzed during a sulphite cook. Not only is the pulp yield influenced by this hydrolysis, but the pulp quality depends on the manner in which this hydrolysis proceeds. The object of the present study was to determine the relative resistance of the polysaccharides to acid attack. Samples of the liquor were taken from the digester at intervals during the cook, and the various sugars in these samples were determined qualitatively by means of paper partition chromatography. The woods cooked were spruce, pine, aspen, and birch. All waste liquors were shown to contain (at some stage of the cook) mannose, galactose, glucose, xylose, and arabinose, but the quantitative differences were marked, especially in the case of mannose and galactose in the waste liquors from hardwoods on the one hand, and from softwoods on the other. However, the wood species does not influence the order in which the sugars are removed. Even before the temperature in the digester had reached 100°C., arabinose was found in the liquor. Soon thereafter (or at times simultaneously with arabinose), xylan and galactan hydrolyses were indicated. Hydrolysis of the mannan, however, starts much later—not before a temperature of 130° is reached. Glucose appears thereafter, primarily as a result of degradation of cellulose. In the production of a dissolving pulp, glucose was discovered in the liquor only when the temperature had reached 140°. However, glucose also was present to a certain extent when a cooking temperature was maintained several hours at 130°, as is customary for strong sulphite pulps. An excellent series of chromatograms show the relationship between appearance of the sugar and cooking time.

ANON., *Can. Chem. Processing* 35, No. 12: 1004, 1006, 1008, 1010–1011 (Dec., 1951); *B.I.P.C.* 22: 392 (1952).

The sources and production of alcohol are discussed, including its recovery from waste sulphite liquor, and methods for the preparation of synthetic alcohol are described.

CHURCHILL, W. S., *Progressive Fish-Culturist* 14, No. 1: 3–9 (Jan., 1952); *B.I.P.C.* 22: 622 (1952).

A detailed study is reported on the use of torula yeast,

which is produced from waste sulphite liquor, as a food supplement in the rearing of trout. The results show that the yeast has a favorable effect on the growth rate of the fish and provides a nutritious and relatively economical supplement to their usual meat diet.

Dunn, C. G., *Wallerstein Labs. Communs.* 15, No. 48: 61–79 (March, 1952); *B.I.P.C.* 22: 703 (1952).

An excellent, comprehensive review of the literature on food yeast, its production, composition, and uses is presented. The various organisms suitable for food-yeast production, the conditions affecting their growth, and methods of production on various types of substrates are discussed.

Ekholn, E., *Paper Mill News* 75, No. 22: 15–16 (May 31, 1952); *Pulp and Paper* 25, No. 8: 48 (July, 1951); *B.I.P.C.* 22: 726 (1952).

The economics of producing ethyl alcohol from waste sulphite liquor are discussed as applied to the Pacific Coast area. Indications are that the cost of alcohol produced from this source would be $0.20 per gallon as compared with $0.12 to 0.15 per gallon for alcohol from molasses or for synthetic alcohol. The only available market would be the Middle West, and transportation costs would also be an important factor. Aside from the economics involved, however, alcohol production would probably solve the pollution problem through sufficient reduction in B.O.D. demand of the waste liquor.

Jensen, W., and Rinne, P., *Paper and Timber (Finland)* 34, No. 4a: 137–139 (Special issue, April, 1952); cf. *B.I.P.C.* 21: 353; 22: 861 (1952).

Fusel oil obtained in the production of alcohol from waste sulphite liquor in 15 mills in Finland has been analyzed by distillation in a spinning-band column designed by Björkman and Olavi (cf. *Svensk Kem. Tid.* 58: 145–150 (1946)); the results are presented in a table and show quite large variations, although the general trends are similar. Every sample of fusel oil was distilled before and after drying. The water was removed by treating the oil successively with ignited sodium sulphate and magnesium nitride. Four examples of distillation curves obtained in these experiments are included. In one case the chemical constitution of each fraction was checked after redistillation by determining the specific weight, elemental composition, molecular weight, hydroxyl number, and optical activity. In all other cases the fractions were classified according to their boiling points. The percentages of identified compounds listed in the table have been calculated from the horizontal distances between the mid-points of the vertical sections of the distillation curves.

Perlman, D., Brown, W. E., and Lee, S. B., *Ind. Eng. Chem.* 43, No. 9: 1996–2012 (1952); cf. *B.I.P.C.* 22: 103; 23: 96 (1952).

A review of the literature on fermentation during the past year is presented, including references on waste sulphite liquor and alcohol and yeast prepared from it.

Anon., *Can. Chem. Processing* 36, No. 11: 32–34 (Oct., 1952); *B.I.P.C.* 23: 158 (1952).

The process for converting the waste sulphite liquor (40,000 gal. per hr.) produced by the Canadian International Paper Co. at its Gatineau mill to high-grade ethyl alcohol by its subsidiary, Commercial Alcohols, is described, including the individual phases of neutralization, fermentation, and distillation. The plant is completely equipped with instruments for automatic centralized control.

Samuelson, O., Gabrielson, G., and Hartler, N., *Svensk Papperstidn.* 55, No. 16½: 613–619 (Sept. 4, 1952); *B.I.P.C.* 23; 230 (1952).

The distillation of alcohol during the evaporation of the fermented waste liquor was studied and formulas were derived which make it possible to calculate the theoretical alcohol yield. The liquor-vapor equilibrium is discussed, and equations for the calculation of the equilibrium at subatmospheric pressures are given. In conclusion, the recovery of alcohol in full-scale operation has been studied in two evaporator plants, and the results are compared with those which were calculated according to the methods presented in this article. When standard evaporators are used, the agreement was found to be very good; with more elaborate constructions, the results were less satisfactory.

FERTILIZERS

Burstrom, H., *Kgl. Lantbruksakad. Tid.* 90: 336–354 (1951); *C.A.* 46: 3697 (1952).

Wheat was grown in soil in enameled pots in green houses with or without additions of waste liquor and other fertilizers, and the green plants were analyzed for K, Na, Ca, N, P, Mn, Fe, and Si. With heavy applications of waste liquor the yield increased regularly by 60 to 100%. Primarily this is explained as due to the action of Mn on the highly Mn-deficient soil used, together with the improved water balance of the crop. The greatest effect was obtained at a low water supply in which waste liquor increased the drought resistance of the plants. The favorable effects are counteracted by an impeded N utilization, predominating at low applications of waste liquor.

Stephenson, R. E., and Bollen, W. B., *Tappi* 32, No. 9: 422–426 (1949); cf. *B.I.P.C.* 16: 310; 20: 124 (1949).

Field experiments over a period of 5 years were conducted to determine the feasibility of using diluted waste sulphite liquor in irrigation waters. Rates of 10, 20, 40, 80, and 120 tons an acre were applied annually to plots on which potatoes, corn, beans, and cabbage were grown. The various crops were rotated. The results showed that none of the liquor applications had much effect upon the soil after 5 years of treatment. No consistent effect on the growth of crops was noted. The heaviest rate, 120 tons, or about an acre-inch, was somewhat depressing on the growth of some crops. As a general conclusion, based on field and greenhouse studies, 60 tons or about half an acre-inch can be used annually in dilution with irrigation water without harmful effects.

HYDROGENATION

Kleinert, Th., *Monatsh.* 83: 623–628 (1952); *C.A.* 46: 11673 (1952).

Spruce lignin, prepared by the sulphite process with $Ca(OH)_2$ at 150° under pressure, and "organosolv" lignin, prepared by the method of Kleinert and Tayenthal (cf. *C.A.* 26: 590), were dissolved in cyclohexanol and heated in steel autoclaves to 300°. The pressure generated during reaction decreased almost to atmosphere on cooling. A small amount of C_2H_4 was the only permanent gas found. Considerable amounts of C_6H_6 and H_2O were found. All the H_2O could not be accounted for as originating from the dehydration of the cyclohexanol and must have come from the hydrogenation of lignin. Cyclohexanol heated alone under these conditions did not split off either H_2O or H_2, so that lignin must have acted as a dehydrogenating agent. No cyclohexene was found. Lignin could also be hydrogenated with O-free alicyclics, such as cyclohexane and tetrahydronaphthalene, but the reaction was slower than with cyclohexane. Halogen acids catalyzed the reaction. The hydrogenation products of lignin were fractionated. They were thought to contain aromatic and alicyclic compounds and multivalent phenols, some of them methylated. They were not identified individually. The process might have economic importance for obtaining rare phenols from lignin.

NITIAL TREATMENT OF WASTE SULPHITE LIQUOR

vaporation and burning

YRKLUND, G., Swed. pat. 132,413 (July 17, 1951); *C.A.* 46: 766 (1952).

To obtain highly concentrated waste liquors in a two-stage ooking process, there is used in the preparation of the liquor or the first stage a liquor which has been drawn off from a pre- ous cooking process (with addition, if necessary, of CaO and O_2 up to the required strength). The first stage of the cook- g is continued until most of the noncellulosic constituents ave been removed, and the liquor contains at least about) grams per 100 ml. of dry matter; enough liquor is then ithdrawn so that the content of dry matter of the liquor at e end of the second stage is about the same as that ob- ined in a first-stage process, e.g., 11 to 15 grams per 100 ml. resh liquor is then added to make up the liquor for the second age. At the end of the cooking process the cellulose is ashed, and the wash liquors are used partly for washing out e used liquor from the second stage of a previous cooking peration, and partly for making up fresh liquor for the cond stage of the next cooking operation. See also Can. t. 459,308 (Aug. 30, 1949); *B.I.P.C.* 20: 149 (1949).

ARSSON, E. J., and JONSSON, J. H., Brit. pat. 656,283 (Aug. , 1951); *C.A.* 46: 2802 (1952).

See Swed. pat. 126,919 (*C.A.* 44: 3713), U. S. pat. 2,496,- 0 (*C.A.* 44: 6624), and Can. pat. 481,256; *B.I.P.C.* 22: 2 (1952).

APETERIES DE GASCOGNE (Société anon.) and GADRET, R. , Brit. pat. 657,511 (Sept. 19, 1951); *C.A.* 46: 2802 (1952).

See U. S. pat. 2,535,730 (*C.A.* 45: 2207).

TTERVALL, K. E., Swed. pat. 132,978 (Sept. 18, 1951). ddition to Swed. pat. 128,951 (*C.A.* 45: 354); *C.A.* 46: 77 (1952).

The gaseous mixture obtained by dry distillation of the ed waste liquors is subjected to heat treatment at 700 to)° in the presence of an oxide or basic compound of iron ereby the sulphur in the gas is converted to H_2S and ab- bed by the iron compound. The compound is then sted to give up the sulphur as SO_2 which is used for pre- ring fresh liquor. Burnt pyrites are preferably used as the n compound.

LSTROM, A., *Das Papier* 5: 401–409 (1951); *C.A.* 46: 25 (1952).

Recent Swedish developments and operations with the annel-switching system for burning waste sulphite liquor reviewed. Higher temperatures aggravate incrustation. pecial noncooled combustion chamber, in which the liquor burned in intimate contact with air, results in complete mbustion. Three such installations are in operation. hen the combustion chamber is first preheated with an oil rner, additional fuel becomes unnecessary in maintaining ntinuous combustion.

HOLANDER, A., *Tappi* 35: 1–4 (1952); *C.A.* 46: 6829 952).

Burning of waste sulphite liquor, when compared with coal an equivalent heat basis results in 6 to 8 times the amount SO_2 and twice the ash. Ash composition from burning % liquor in a Loddby furnace was: Fe_2O_3 + Al_2O_3, 1; SO_4, 54; $CaCO_3$, 3; CaO, 38; CaS, 1; and $CaSO_3$, 2%. ne progress has been made in scrubbing the flue gases to move fly ash and some of the SO_2.

CK and FRANKE, Ger. pat. 803,350 (April 2, 1951); *C.A.* 6876 (1952).

Apparatus for producing and recovering raw materials n pulpy fibrous, disintegrated substances, such as sugar from beet slices, resins from wood, salts from ore-leaching plants, and sulphite or sulphate waste liquors.

NILSSON, N. E., U. S. pat. 2,591,188 (April 1, 1952); *C.A.* 46: 7330 (1952).

Recovering inorganic solvent from waste sulphite liquor.

SCHOLANDER, A., *Svensk Papperstidn.* 55: 90–100 (1952); *C.A.* 46: 9303 (1952).

Factors affecting the dissolving of $CaSO_4 \cdot 2H_2O$ and $CaSO_4$ are studied for the purpose of increasing the understanding of the formation of incrustants during evaporation of Ca-base waste sulphite liquor. Literature and theoretical considerations are reviewed, and experiments with rotating cylinders of $CaSO_4 \cdot 2H_2O$ and $CaSO_4$ in H_2O as well as aqueous solutions of glucose, NaCl, dichloroacetic acid, SO_2, HCl, and HNO_3 are described. The dependence of dissolving rate on temperature, viscosity, flow rate, ionic strength, and pH are evaluated. The results are discussed relative to optimum conditions for dissolving $CaSO_4 \cdot 2H_2O$ in evaporating equipment. The highest dissolving rates for $CaSO_4 \cdot 2H_2O$ and $CaSO_4$ were with 23% HNO_3 solution.

GRALOW, B. B., *Pulp Paper Mag. Can.* 50, No. 9: 100–101 (1949); *B.I.P.C.* 20: 123 (1949).

The author reports solubility data gathered from the literature on calcium sulphate and sulphite, which are the principal causes of the scale formation during the evaporation of waste sulphite liquor. It is pointed out that engineering calculations cannot be based on the solubility of a pure aqueous system of calcium sulphite because the presence of sugars and calcium sulphate in sulphite waste liquor has a drastic effect on the solubility of calcium sulphite.

THE SULPHITE PULP MANUFACTURERS' RESEARCH LEAGUE, INC., *Paper Trade J.* 130, No. 1: 19–20, 22 (1950); *B.I.P.C.* 20: 433 (1950).

The present status of evaporation and burning of waste sulphite liquors in Sweden is reviewed under the four headings: liquor collection, evaporation, burning, and disposal of fly ash. The development of burning techniques has lagged considerably behind evaporation, with the result that sound principles for burning this material in quantity are not currently known. Three of the mills which concentrate liquor use all of the concentrate for road surfacing. Of the other six mills, two are burning their concentrate, and the remaining four mills are burning part of it and using the rest as a road binder. All mills which burn waste sulphite liquor are doing it in existing boilers with auxiliary fuels, such as wood refuse, coal, oil, or a combination of these. Fly ash from liquor burning presents a serious problem. The possibilities of transposing Swedish practice to Wisconsin mills are considered and the many problems involved are pointed out. A list is appended of the mills and establishments visited and the persons interviewed during the trip on which this information was collected.

LARSSON, E. J., and JONSSON, J. H. U. S. pat. 2,496,550 (Feb. 7, 1950); *B.I.P.C.* 20: 541 (1950).

A process is described for the recovery of the alkali salts from alkaline waste sulphite liquor. The waste liquor is evaporated and burned to form a molten mass containing sodium sulphide; the molten mass is dissolved in water, and carbon dioxide is introduced into the resulting solution, thus sodium bicarbonate. The addition of carbon dioxide is continued until the solution is almost saturated with sodium bicarbonate; the hydrogen sulphide is driven off by heating, and additional carbon dioxide is introduced. Sodium bicarbonate crystallizes from the solution and is separated from the liquid.

ANON., *Pulp & Paper* 24, No. 3: 36–37 (March, 1950); *B.I.P.C.* 20: 559 (1950).

A brief illustrated description of the experimental Conkey flatplate heating surface evaporator at the Interlake mill of the Consolidated Water Power and Paper Co., Appleton, Wis. (operated by the Sulphite Pulp Manufacturers' Research League) is given, which utilizes the Rosenblad channel-switching system for avoiding scale formation on the heating surfaces. The single-effect unit reduces comparatively strong (undiluted) waste sulphite liquors to approximately 50 to 55% solids at the rate of 300 gal. per hr. A large percentage of this condensed liquor is being shipped to firms which are developing combustion equipment. The evaporated liquor has a high B.t.u. content; however, the disposal of the calcium-base fly ash (about 200 lb. per ton of pulp) poses a serious problem. Unfortunately, some of the largest sulphite mills are in regions where there seems to be absolutely no demand from farmers for use of this ash as fertilizer, the only important possible outlet now known.

General American Transportation Corp., *Chem. Processing* 13, No. 4: 94–95 (April, 1950); cf. *B.I.P.C.* 20: 559; 20: 637 (1950).

An illustrated description of the Conkey flat plate heating surface evaporator is given, in which the liquid and steam sides are periodically switched, so that any scale deposited from the liquid is dissolved at timed intervals by vapor and condensate.

Scholander, A., *Norsk Skogind.* 4, No. 3: 63, 65–71 (March, 1950); cf. *B.I.P.C.* 20: 669; 20: 818 (1950).

The author discusses essentially the same topics as in the previous reference, although the two articles are not identical.

Melander, K. H. A., Savo, G. E., and Johanson, T. I., Can. pat. 466,880 (July 25, 1950); *B.I.P.C.* 20: 930 (1950).

Waste sulphite liquor at about 80 C. is treated with slaked lime until a pH of 8.8 to 9 is reached, giving a precipitate of calcium sulphite and calcium sulphate and a small quantity of organic substances; the filtrate is then treated with additional slaked lime until the pH is 11.5 to 12, precipitating calcium ligninsulphonate; 5 parts of the salt are suspended in water, treated with 1 part of sodium sulphate, and then with sulphur dioxide until the pH is 2 to 4, the reaction being completed by heating to 100 C. Evaporation of the filtrate gives sodium ligninsulphonate, a sample of which contained 17% ash, 0.3% calcium, and 7% sodium. The presence of the sulphur dioxide during the evaporation gives a light-colored product, which is readily soluble.

Kennedy, E. H., and Coldwell, F. H., *Paper Mill News* 73, No. 31: 12, 14–17 (Aug. 5, 1950); *Pulp and Paper* 24, No. 11: 84, 86, 88, 90 (Oct., 1950); *B.I.P.C.* 21: 47 (1950).

Tests by the Sulphite Pulp Manufacturers Research League with the burning of waste sulphite liquor (about 52% dry solids) in a completely waterwalled furnace installed by Combustion Engineering-Superheater, Inc. at the Nekoosa, Wis., mill of the Nekoosa-Edwards Paper Co. are described. The main purpose was not a duplication of previous tests, but the clarification of certain points, such as the efficiency at which the liquor could be burned in such a unit, the amount of liquor which could be used in relation to the total fuel used, the completeness of combustion, and the possibility of controlling the fly-ash nuisance with a commercial collector found satisfactory for powdered coal. Details of the boiler, furnace, sulphite liquor equipment, and the testing procedures are given. Both the mechanical and the steam-atomizing types of atomizers were used for the burning of the liquor; the mechanical equipment gave the better results. The atomizing tips of carbon steel showed rapid erosion, and a different material will have to be selected. Steam-atomizing tips with their lower liquor velocities will stand up longer under service than mechanical atomizing tips. A liquor-burning efficiency of 74% was reached in the tests, as compared with 83% obtained by the boiler unit with coal. The difference is occasioned principally by the additional moisture in the liquor which must be evaporated and superheated to the exit gas temperature. From the comparatively short tests it does not appear that any trouble from furnace, boiler tube, or superheater-tube fouling will be encountered as long as the liquor is atomized sufficiently, and the furnace is large enough to burn the fuel completely. The problem of handling the ash is similar to that of pulverized coal ash, and apparently can be accomplished in the same way and by the same means. However, about, 1.5 to 2 times as much ash results from burning sulphite liquor as from coal for the same heat input. To permit economical operation, liquor must be collected at maximum solids content and evaporated to as great a degree as can be done physically. These conditions will vary according to cooking procedures, so that each mill considering this method of disposal will have to evaluate its own problem. However, the general statement can be made that no mill can hope to break even in these operations, until it can produce a liquor, evaporated to burnable consistency, at a cost considerably less on a B.t.u. basis than the commercial fuel it is presently using.

Brunes, B., *Paper and Timber (Finland)* 33: 273–279, 302, 304–309 (1951); *Paper Trade J.* 133, No. 25: 24–25, 28, 30; No. 26: 18–20, 22, 24, 26 (1951); *B.I.P.C.* 22: 284 (1951).

Swedish developments in the recovery, evaporation, and burning of waste sulphite liquor during recent years are reviewed; diagrams for calculating the net fuel savings through the utilization of the waste liquor are included.

Jacoby, H. E., *Pulp and Paper* 25, No. 13: 100, 102–103 (Dec., 1951); cf. *B.I.P.C.* 20: 786; 22: 328 (1952).

A summary of the author's impressions during a recent trip to Sweden is presented, covering the contrast between Swedish and United States requirements for the removal of waste sulphite liquor, temperature limitations, types of Swedish equipment, channel-switching types, optimum concentrations, and maintenance problems. The author concludes that the experience of Swedish practices in the evaporation of waste calcium-base sulphite liquor indicates that successful results can also be achieved under conditions prevalent in the United States. Station switching of the Rosenblad-type evaporator will permit 7-day operation per week within proper temperature and pressure limitations. For refractory-type furnaces a liquor concentration can be readily achieved which will give good combustion. The materials of construction are standardized, and maintenance is normal.

Badger, W. L., and Lindsay, R. A., *Ind. Eng. Chem.* 44, No. 1: 50–53 (Jan., 1952); cf. *B.I.P.C.* 21: 393; 22: 403 (1952).

The literature of the past year on the theory and practice of evaporation is reviewed. It concerns, for the most part, the problems involved in the evaporation of waste sulphite liquor.

Hill, H. S., and Beath, L. R., Can. pat. 479,770 (Dec. 25, 1951); *B.I.P.C.* 22: 455 (1952).

Waste sulphite liquor is withdrawn from a reservoir of concentrated liquor, combined with dilute liquor, and pumped to an electrical conductance heater, where it is heated between spaced electrodes and concentrated by evaporation. The resultant water vapor is removed in a cyclone separator, and a portion of the concentrated liquor is returned to the reservoir; the remainder of the liquor is bled off to a storage tank. The flash steam which results from the evaporation process is utilized for the cooking of pulp.

Sorenson, H. A., *Can. Chem. Processing* 36, No. 4: 36 (April, 1952); *Chem. Eng. News* 30, No. 14: 1410 (April 7, 1952); *Paper Ind.* 34, No. 1: 46–48 (April, 1952); *Mech. Eng.* 74, No. 5: 410–411 (May, 1952); *B.I.P.C.* 22: 695 (1952).

A method for burning calcium-base waste sulphite liquor without the use of auxiliary fuels is described. Stable combustion of the liquor was maintained in a preheated refractory-lined furnace by using waste sulphite liquor which was preheated by a steam coil in the bottom of the storage barrel; a conventional type oil burner with steam-atomizing nozzle was installed for firing the liquor, and compressed air, instead of steam, was supplied as the atomizing medium. A combustion efficiency of 76% was obtained which could be substantially improved by redesigning the furnace.

ICHOLANDER, A., *Paper and Timber* (*Finland*) 34, No. 4a: 140–151 (1952); *B.I.P.C.* 22: 824 (1952).

The present status of evaporation of waste sulphite liquor in Sweden and future trends and developments are reviewed. Problems connected with the evaporation and burning of the waste liquor are discussed, including the recovery of the liquor, difficulties caused by the ash in the boiler and the surroundings of the plant, flue-gas problems, the risk of sulphur dioxide damage caused to vegetation, the elimination of the sulphur dioxide by a scrubbing process, and water-pollution problems caused by the solubility of the ash and sludge from the scrubber; possible applications of the ash are listed.

LIASSEN, R., *Sewage Ind. Wastes* 24, No. 7: 851–873 (July 1952); *B.I.P.C.* 22: 905 (1952).

In a general discussion of industrial waste problems, the first section is devoted to the evaporation of waste calcium-base sulphite liquors, with particular reference to Swedish installations, as reported by Harold E. Jacoby.

OLLEY, R. S., *Pulp and Paper* 26, No. 10: 98, 100, 102 (Sept., 1952); *B.I.P.C.* 23: 128 (1952).

A report on the experience with evaporation and burning of calcium and ammonia-base waste sulphite liquors at the Interlake sulphite mill of Consolidated Water Power and Paper Co. at Appleton, Wis., is presented, including methods of initial burning, a new cyclone furnace, and heat and ash problems with calcium-base liquors and experiments with ammonia-base liquors. The entire problem must be assessed economically. The investment cost in the evaporation equipment and the cost of operating it are sufficiently large to offset any possible profit if the desired efficiencies are not maintained throughout. Adding the cost of a new boiler equipment to this investment completely eliminates any possibility of breaking even. However, if the cost of the boiler expansion is charged as a necessary investment to produce increased steam and/or power for pulp- and paper-mill processing, there is some reason to believe that it will become economically feasible. If markets can be found for the concentrated liquor, disposal without burning might prove economical.

..ON., *Pulp and Paper* 26: 92, 94 (1952); *B.I.P.C.* 23: 246 (1952).

Three Wisconsin sulphite mills at Rhinelander, Appleton, and Green Bay are now installing stainless-steel Rosenblad pitch-system evaporators. At Rhinelander, an attempt will be made to market dry powdered waste liquor; its evaporator will handle the waste liquor from the digesters and blast plant. The two other installations will burn their liquors for energy values.

HOLANDER, A., *Svensk Papperstidn.* 55: 620–621 (1952); *B.I.P.C.* 23: 246 (1952).

The sulphur balance during the evaporation of waste sulphite liquor was studied at four different stages of the process; the sulphur losses in the thick liquor, condensates, counter-pressure steam (measured at the last effect), and venting gases are given as a percentage of the sulphur input in the spent liquor. The results obtained in five different sulphite mills making different products (paper or dissolving pulps) are presented in tabular form; they show considerable variations for the different liquors. The sulphur losses in condensates, counter-pressure steam, and venting gases increase with increasing temperature of the process and decreasing pH of the liquor.

SILLEN, G., and ANDERSSON, T., *Svensk Papperstidn.* 55, No. 16½: 622–631 (1952); *B.I.P.C.* 23: 282 (1952).

The equilibria between gas and ash—when calcium or magnesium waste sulphite liquor is burnt under various conditions—are discussed with special emphasis on the recovery of sulphur. Logarithmic diagrams are used where the equilibrium pressure of each gas is plotted as a function of the equilibrium pressure of oxygen. For convenience, the symbol rO—log PO_2 has been introduced, analogous to Clark's rH. These "rO diagrams" are easily constructed and give a good survey of the equilibria. With calcium base, the recovery as calcium sulphate is easily achieved, but does not seem attractive. The sulphur can be recovered either as sulphur dioxide in the gas or as calcium sulphide in the ash. The suitable ranges of temperature and excess or deficit of oxygen (expressed as a percentage) are given in a diagram. Uncertain factors in both cases are the rate of attainment of the equilibrium and the rate of secondary reactions on cooling the ash or gases. With magnesium base, all sulphur can be obtained in the gas (as sulphur dioxide or hydrogen sulphide) under a very wide range of conditions. It does not seem possible to obtain magnesium sulphide by combustion.

Miscellaneous Processes

HÄGGLUND, E., and STOCKMAN, L., *Paper Mill News* 75: 44–46, 48 (1952); *B.I.P.C.* 22: 695 (1952).

The work on sulphite cooking with recycling of waste liquor (cf. *B.I.P.C.* 21: 732–733) and on the influence of formic acid (cf. *B.I.P.C.* 22: 205) is discussed.

MANNBRO, N., *Svensk Papperstidn.* 55, No. 17: 665–667 (Sept. 15, 1952); *B.I.P.C.* 23: 205 (1952).

A procedure, termed Silfit process, for the utilization of waste sulphite liquor in neutral semichemical pulping is described; it has certain similarities with the Silfat process (cf. *B.I.P.C.* 21: 498). The chemicals required for the neutral sulphite cook are dissolved or prepared in waste calcium or sodium bisulphite liquor. During the evaporation and combustion of the spent neutral sulphite liquor the combustible matter and the sulphur in the waste sulphite liquor can be utilized. The soda smelt is dissolved in waste sulphite liquor and, on treatment with gases which contain carbon dioxide, hydrogen sulphide is recovered which can be oxidized to sulphur dioxide. Sulphur dioxide can be used for producing sulphite in the carbon dioxide-treated liquor or sent to the sulphite mill. In laboratory cooks, semichemical pulps with good strength properties and in a yield of about 70% were obtained. Patent applications for the new method have been made.

LABORATORY INVESTIGATIONS

KAHILA, S. K., *Paper and Timber* (*Finland*) 32B: 173–176 (1950); *C.A.* 46: 1764 (1952).

Triplett's method (*C.A.* 34: 8269) for determination of the organic matter content of sulphite cooking liquor was modified to prevent escape of volatiles during analysis, to insure complete oxidation, and to allow analysis of liquors containing relief gases. The procedure is: pipet 2 ml. liquor into a 250-ml. Erlenmeyer flask containing 75 ml. water and 2 ml. starch-iodide indicator; titrate with 0.125 *N* KIO_3 solution (B). Pipet 10 ml. of 1.25 *N* solution of KIO_3 in 90 volume % H_2SO_4 into a 100-ml. Erlenmeyer flask containing 4 to 5 glass beads and equipped with a standard taper ground joint, add 2 ml. liquor, mix carefully, and put on a reflux con-

denser. Hold the flask at 200° for 2 hr., cool, and wash the contents into a 250-ml. Erlenmeyer flask with 50 ml. H_2O. Place the Erlenmeyer flask on a steam bath until the I_2 dissolved in the liquid has disappeared completely, cool, add 15 ml. 5% $NaHCO_3$ solution, and swirl to let CO_2 escape. Add 10 to 15 ml. 15% KI solution and titrate to starch indicator with 0.125 *N* Na_2SO_3 (C). Titrate a blank of 10 ml. of the 1.25 *N* KIO_2 with 0.125 *N* $Na_2S_2O_3$ in the same manner (A). The organic number = A − (B + C).

Patterson, R. F., Keays, J. L., Hart, J. S., Strapp, R. K., and Luner, P., *Pulp and Paper Mag. Can.* 52, No. 12: 105–111 (1951); *C.A.* 46: 2293 (1952).

The extent to which ultraviolet light of 280 mu wave length is absorbed by dilute solutions of sulphite digester liquor is a rapid and accurate method of determining the concentration of lignin present. Other substances in the digester liquor do not introduce more than 1% error in the determination. The method offers some improvement over liquor-color determinations as a means of commercial cooking control and it furnishes a valuable tool for fundamental studies of lignin sulphonation in experimental digester investigations.

Polcin, J., *Chem. Zvesti* 5: 300–307 (1951); *C.A.* 46: 3903 (1952).

Inorganic and aldehyde-bound sulphur dioxide is determined potentiometrically by double buret titration or by titration with Pt capillary electrode.

Borisek, R., and Polcin, J., *Chem. Zvesti* 5: 322–330 (1951); *C.A.* 46: 4223 (1952).

Both qualitative and quantitative reactions of lignin with formaldehyde have been revised. HCHO reacts with the side chain of lignin and various types of lignin can be differentiated. Sulphite lignin and ethanol lignin show best reactions. The reaction appears to be of the aldol type.

Borisek, R., *Chem. Zvesti* 5: 331–338 (1951); *C.A.* 46: 4225 (1952).

Treating with NH_3 under pressure is equally good as with NaOH, for the liberation of phenolic groups.

Borisek, R., *Chem. Zvesti* 5: 338–355 (1951); *C.A.* 46: 4225 (1952).

Nitrogen is firmly bound on the side chain in the reaction of lignin with hexamethylenetetramine. This reaction can be used as an analytical method for differentiating various types of lignin.

Wiley, A. J., *Tappi* 34: 553–556 (1951); cf. *C.A.* 45: 9794 (1951); *C.A.* 46: 4225 (1952).

Wiley gives descriptive information on the organization and research program of the Sulphite Pulp Manufacturer's Research League.

Andersen, C. C., *Kgl. Norske Videnskab. Seskab. Forh.* 23, No. 11; 41–46 (1950); *C.A.* 46: 4789 (1952).

Freudenberg lignin was digested with $NaHSO_3$ and SO_2 of 6.25 and 9.35% total SO_2 and 4.36 and 5.10% free SO_2 at 135°C. for 18 hr., giving soluble ligninsulphonic acids with 6.00 and 7.65% sulphur. These were dried at 50° under vacuum and were then heated in an oil bath in a N atmosphere for 1 hr. at 10° intervals between 90 and 180° with the following percentage of SO_2 split off at each temperature: 1.8, 1.9; 6.0, 7.4; 18.2, 19.5; 40.7, 41.0; 70.5, 70.2; 88.5, 87.9; 93.8, 93.0; 98.2, 97.6. Longer heating at lower temperature split off more SO_2; thus all SO_2 was split off by heating ligninsulphonic acid at 125° for 4 hr. Thioglycolic acid lignin was prepared from sprucewood containing 9.2% sulfur or 26.4% $HSCH_2COOH$. This was heated in the same way, at a pressure of 8 mm. Hg to prevent decomposition of the acid, at the following temperatures with the percentage loss in sulphur shown: 80°, 1.1; 100°, 6.5; 120°, 43.2; 150°, 50.0; 200°, 56.1; 250°, 69.7%. Up to 120 the decomposition of thioglycolic acid lignin coincides with that of lignin sulphonic acid. At higher temperatures the decomposition decreases. This is interpreted as showing that 50% of the sulphur is bound in thioglycolic acid lignin the same as lignin sulphonic acid, whereas the other 50% is more firmly bound.

Andersen, C. C., *Kgl. Norske Videnskab. Seslkab. Forh.* 23; No. 11; 130–135 (1950); *C.A.* 46: 4789 (1952).

Methyl, Et, Bu, and iso-Am lignins were prepared by heating in the corresponding alcohol in the presence of HCl. These lignins were heated dry in a N atmosphere at different temperatures as before. The amount of introduced alkoxyl split off was about 30% at 150°, over 80% at 200°, and 100% at 235 to 250°. In each case, the residual lignin was analyzed for the original MeO content. The original MeO, is, therefore, more firmly bound than the introduced alkoxyl groups.

Kratzl, K., and Keller, I., *Monatsh.* 83: 197–204 (1952); cf. *C.A.* 44: 8637 (1950); 46: 5837 (1952).

Spruce ligninsulphonic acid and a number of model substances were subjected to alkaline hydrolysis and the AcH and 4-hydroxy-3-methoxybenzaldehyde formed were determined. Spruce ligninsulphonic acid (MeO 12.4, sulfur 4.8, and ash 12.1%), isolated from its quinoline salt, was hydrolyzed with NaOH solutions of increasing concentrations which gave increasing yields of AcH. With 0.1 *N* NaOH for 6 to 14 hr., .02 to .04% AcH, and 0.05 to 0.1% 4-hydroxy-3-methoxybenzaldehyde were obtained. The highest yields resulted with N and 2 *N* NaOH, whereby 1 mole AcH per 15 to 20 MeO groups was formed. The yield of AcH was always greater than that of 4-hydroxy-3-methoxybenzaldehyde probably because of secondary reactions which 4-hydroxy-3-methoxybenzaldehyde undergoes. The model compounds were hydrolyzed with *N* NaOH to give the following results: coniferylaldehyde, AcH 76.5, 4-hydroxy-3-methoxybenzaldehyde 71.5%; glucoconiferylaldehyde (prepared by the oxidation of coniferin with air in the presence of Pt black), AcH 9.67, 4-hydroxy-3-methoxybenzaldehyde 37.04%; 3,4-dimethoxycinnamaldehyde, AcH 76.7, veratraldehyde 60.2%. Methylated ligninsulphonic acid (MeO 26.4, S 3.34%) upon alkaline hydrolysis yielded a mixture of AcH, 4-hydroxy-3-methoxybenzaldehyde, veratraldehyde, and an unidentified carbonyl compound. The fact that 4-hydroxy-3-methoxybenzaldehyde is obtained from a methylated spruce ligninsulphonic acid (assuming that it has been completely methylated) indicated that a part of the 4-hydroxy-3-methoxybenzaldehyde from unmethylated spruce lignin-sulphonic acid must originate from central lignin building stones or masked guaiacyl groups.

Kleinert, Th., and Floriantschitsch, M., *Monatsh.* 83: 36–37 (1952); *C.A.* 46: 5838 (1952).

During the study of the foam-producing principle of beech waste sulphite liquor, the liquor was extracted with Et_2O and Et_2O-EtOH to yield a product containing 23 to 24% MeO and thought to be a diarylbutane similar to conidendrin. The procedure of Lackey, Moyer, and Hearon (*C.A.* 44: 1498) for the precipitation of conidendrin from coniferous waste sulphite liquors by means of such solvents as trichloroethylene and toluene did not work in the case of the beech liquor but was improved somewhat by the addition of Kieselguhr. The product was isolated from the solvents as a crude mixture which the authors intend to purify by adsorption chromatography.

Hägglund, E., Lindgren, B. O., and Saeden, U., *Svensk Papperstidn.* 54: 795–798 (1951); *C.A.* 46: 6827 (1952).

As continuation of the study on wood sulphonation at 135° with sulphite of about neutral pH (cf. *C.A.* 45: 8762 (1950)) birchwood (*Betula verrucosa*), representing a dicot-

yledon, and *Cana guadua* (*Guadua angustifolia*) (a grass from Ecuador closely related to bamboo), representing a monocotyledon, were digested with acid and neutral sulphite solutions at 135° for various lengths of time. The dissolving of lignin from birchwood proceeded at a similar slow rate at around neutral pH as previously found for spruce and, therefore, also may involve splitting of alkoxybenzyl alkyl ether linkages. In contrast a major part of lignin from *Cana guadua* dissolves much faster. The undissolved lignin from *Cana guadua* was sulphonated to a degree corresponding to S/-OCH_3 of about 0.3, which is similar to spruce, but undissolved lignin after neutral cook of birchwood had S/OCH_3 of about 0.15; this was found also for other dicotyledons, such as paper birch, aspen, and maple. This may mean that the lignins in dicotyledons have a lower content of that type of sulphonatable groups which are termed A groups by Hägglund and co-workers.

KITAO, K., *Mokuzai Kenkyu* No. 8: 5–8 (1952); *C.A.* 46: 7326 (1952).

The alcohol-benzene extracted wood meal (l.g.) of beech, birch, spruce, and pine was digested with a neutral sulphite pulping liquor (10 ml.) containing Na_2SO_3 (160 grams per liter) and $NaHCO_3$ (50 grams per liter) at pH 8.2, in a small sealed glass tube, raising the temperature to 115° in 30 min., leaving for 1 hr., raising again to 166° in 1 hr., and leaving there for a definite time. The yield of pulp, combined sulphur, and MeO group in the wood residue were determined. The ratio S/MeO represents the degree of sulphonation of the undissolved ligninsulphonic acid of the solid matter; that of the hardwood was considerably lower than that of the softwood. Shortly after the start of raising temperature, the ratios of the soft and the hardwood reached 0.3 and 0.1, respectively; no increase was observed thereafter.

KITAO, K., *Mokuzai Kenkyu* No. 8: 9–12 (1952); *C.A.* 46: 8326 (1952).

The wood meal was digested with an acid sulphite pulping liquor containing 53.1 grams per liter SO_2, 13.3 grams per liter Na (pH 2). The ratio S/MeO reached shortly 0.3 and 0.1, and then 0.5 and 0.2 with the soft and the hardwood, respectively. They increased further with time without showing a maximum point. The sulphonation of the softwood lignin was always quicker than that of the hardwood.

LEOPOLD, B., *Acta Chem. Scand.* 6: 64–72 (1952); *C.A.* 46: 3765 (1952).

Pure β-ligninsulphonic acids were isolated by precipitation with bis(4-dimethylaminophenyl)methane, 1,5-bis(N-piperidinoacetylamino)anthraquinone, S-1-naphthylmethylthiuronium chloride, 1-(N-piperidinoacetylamino)naphthalene, and 1-(N-piperidinoacetylamino)anthraquinone, and some of the products were analyzed, sulphonated, and oxidized with $PhNO_2$ and alkali. Extracted wood flour (1.68 kg.) from *Picea abies*, in 8.4 liters solution containing 335 grams Na_2SO_3 and 845 grams Na pyrosulphite was heated 1 hr. to 130°, 2 hr. to 135°, and 14 hr. at 135°, and washed with warm H_2O; this gave a total volume of washings and filtrate of 11.5 l. To 100 ml. of washings and filtrate was added an excess of precipitating agent in an equivalent amount of dilute sulphuric acid (in the case of S-1-naphthylmethylthiuronium chloride dissolved in hot H_2O) the mixture stirred, and the volume adjusted to 150 ml., the mixture let stand overnight, the precipitate separated by centrifuging and washed with water, the mother liquor and washings combined, the volume adjusted to 250 ml., and OMe and solids determined on aliquots. The OMe precipitated was 22, 67, 71, 80, and 86% for the above-mentioned precipitating agents, respectively. 5.6 Liters of washings and filtrate was treated with 125 grams 1-(N-piperidinoacetylamino)anthraquinone and an equivalent amount of sulphuric acid, the mixture let stand overnight, the liquor decanted, the precipitate squeezed and converted to the sodium salt by treatment with 1% NaOH in a mortar, the mixture centrifuged, and the precipitate washed with water. To the combined solutions (1 liter) containing the sodium salts of the precipitated ligninsulphonic acids was added 35 grams bis(4-dimethylaminophenyl)methane in sulphuric acid and fraction a_1 separated as above and converted to the Ba salt (a_1). The mother liquor was brought to pH 10, the excess bis(4-dimethylaminophenyl)methane centrifuged, the solution neutralized, 55 grams 1,5-bis(N-piperidinoacetylamino)anthraquinone added, and the precipitate converted to the barium salt as above (a_2). The original solution was treated with 45 grams 1-(N-piperidinoacetylamino)anthraquinone in sulphuric acid, and the precipitate converted to the barium salt (a_3). Fractions a_2 and a_3 were further sulphonated and oxidized with $PhNO_2$ and alkali. The base-precipitated products had a higher sulphur content than low-sulphonated lignin, and the yields of vanillin were higher than for the average lignin, and increased with decreasing molecular weight (33.0, 36.0, and 38.3% vanillin for a_1, a_2, and a_3, respectively). Further sulphonation of the precipitated acids showed that sulphonation proceeded at about the same rate at pH 1.4 as that of low-sulphonated lignin, but the lowest molecular weight fraction contained more structural groups reactive to sulphite. At pH 5.8 the rate was much higher. Ultraviolet absorption curves of a_1, a_2, a_3, and low-sulphonated lignin in water were quite similar. The fact that the curve for a_3 in 0.1 *N* NaOH showed no appreciable displacement of the 280 mmu maximum indicated that the phenolic OH content was about the same as for low-sulphonated lignin.

KULLGREN, C., *Svensk Papperstidn.* 55: 1–12 (1952); *C.A.* 46: 7766 (1952).

Unbleached sulphite pulp contains water-insoluble ligninsulphonates in varying amounts and Kullgren has shown (*C.A.* 31: 4493) that, after exchanging the cation with H ion, free ligninsulphonic acid dissolves by treatment with H_2O or alcohols. The rate of solution is slow at room temperature, is unaffected by acidity of the solution, and is, at least at the start, inversely proportional to the amount of free ligninsulphonic acid dissolved. By the hydrolytic solution, for each sulphonic group there appears a new free acid group—probably carboxylic. The latter group is not free in the solid free ligninsulphonic acid in the pulp; it evidently serves there to bind lignin to lignin. A weak acid group, probably a phenolic OH, is present in solid as well as dissolved free ligninsulphonic acid in the ratio of 1 OH to 1 sulphonic group. The dissolved free ligninsulphonic acid is unstable, probably because of intermolecular change; it darkens by boiling or with addition of alkali. Some nitrates (e.g., Hg nitrate) precipitate the dissolved free ligninsulphonic acid.

KRATZL, K., *Mitt. Osterr. Ges. Holzforsch.* 2: 135–137 (1950); *C.A.* 46: 8365 (1952).

The aromatic structure of isolated lignin is well established. Studies on alkaline oxidation of model substances strongly suggest that aromatization does not occur during the isolation of lignin. The transformation of sugars to aromatics at 160° has not been observed. Kratzl reviews evidence that soluble lignin is aromatic. Spruce was extracted with water (100°). On careful evaporation, 4 to 5% solid residue was obtained. The elementary analysis, H_2SO_4 lignin content, and potential vanillin content of the residue were identical with those of the original wood. Kratzl believes the water extract contains lignin in an aromatic form.

KRATZL, K., and EIBL, J., *Mitt. Osterr. Ges. Holzforsch.* 3: 77 (1951); *C.A.* 46: 8366 (1952).

A review of botanical and chemical evidence for existence of woody tissue (e.g., lignin). The former involves fluorescence microscopy, wood stains, and color reactions. The latter involves MeO content, reactivity with sulphite, oxi-

dation to vanillin, and hydrogenolysis to cyclohexylpropanol. The MeO content may be misleading as a quantitative measure of lignin content, since MeO may be derived from lignin, pectin, or hemicelluloses. For example, in *Pteridophyta*, acid-isolated lignin may contain only 25% of the total MeO. The acid-insoluble content may also be an unreliable measure of the lignin content, since some MeO-bearing, potential vanillin-yielding fraction is acid-soluble. Furthermore, in some plants the presence of such acid-insoluble material as SiO_2 gives a misleading "lignin" content; thus *Schachtelhalme equisetum* maximum gives an acid "lignin" containing 50% SiO_2. The phylogenetic precursors of gymnosperms were examined. *Bryophyta* (moss) give no color reactions. Vanillin is not obtained on alkaline oxidation. On treatment with acid, a humic substance is obtained. The *Pteridophyta* are the first members of the phylogenetic series to show some signs of lignification. Although the amounts present are small, the basic structure of the lignin is similar to that in gymnosperms. The acid-insoluble fraction gives 20% vanillin. Syringaldehyde was not found.

Nakao, M., and Eguchi, H., *J. Japan. Assoc. Pulp Paper Ind.* 6: 109–118 (1952); *C.A.* 46: 8368 (1952).

This paper deals with the mechanism of the sulphite process at low temperature. The results obtained are: sulphonation, delignification, and dissolution of hemicelluloses of wood obey approximately the law of a first-order reaction. The activation energy of sulphonation is 19.0 kcal., of delignification 21.5 kcal., and of dissolution of hemicelluloses of wood 33.5 kcal. The temperature coefficient of sulphonation is 2.2, of delignification 2.4, and of dissolution of hemicelluloses of wood 3.5. The mol ratio of the combined SO_2 and Ca per mol of lignin is always 2:1 at each reaction time and temperature and the maximum S and Ca which combine with a mol of lignin is also approximately 2 and 1 mol, respectively.

Migita, N., and Nakano, J., *J. Soc. Textile Cellulose Ind. (Japan)* 8: 81–85 (1952); cf. *C.A.* 43: 733 (1949); 46: 8852 (1952).

2,3,4,6-Tetramethylglucose was demethylated with HI more easily than was guaiacol carbonate; this indicates a difference in reactivity between the aliphatic and aromatic OMe, which, however, was not sharp enough for quantitative separation of the two radicals. Moreover, the OMe in guaiacol carbonate, trimethylpyrogallol, and anisole showed different reactivities. The OMe in lignin sulphate from broadleaf trees showed the same reactivity as that from conifers, but broadleaf trees seemed to contain unstable OMe not in lignin.

Bethge, P. O., Gran, G., and Ohlsson, K. E., *Svensk Papperstidn.* 55: 44–48 (1952); *C.A.* 46: 9305 (1952).

The colorimetric method developed by Giertz (*C.A.* 40: 1315) and modified for ultraviolet light absorption by Loschbrandt (*C.A.* 45: 350) is further improved by use of 80% H_3PO_4 to hydrolyze the cellulose. Interference owing to hydrolysis products as influenced by time and temperature are thereby largely eliminated. Absorption spectra for sulphite pulp, sulphate pulp, black liquor lignin, ligninsulphonates, and Brauns' "native lignin" are shown to be practically unaltered by 80% H_3PO_4. Beer's law was found applicable in a considerable concentration range and reproducibility is good. A detailed description of the analytical procedure is given. Very pure H_3PO_4 is required with minimum absorption at 280 mmu.

Lindgren, B. O., *Svensk Papperstidn.* 55: 78–89 (1952); *C.A.* 46: 9840 (1952).

The most likely reactions involved in sulphonation of lignin with bisulphite and monosulphite are discussed extensively, based on previously published investigations on experimental digestions of wood, lignin, and lignin model compounds. The several different ways whereby the propyl guaiacyl "lignin monomer" combines to form a lignin unit containing probably four to six "monomers" are outlined. The effect of pH and cooking time on the degree of sulphonation and solubilization of lignin has by various investigators (Hägglund, Erdtman, Mikawa, Lindgren) brought out the concept that distinctly different sulphonation stages are involved because of different sulphonatable groups, some of which are directly reactable, some sulphonatable only after hydrolysis. These groups, the A group which subdivides into the X and Z, the B and the B^1 groups, are defined as to their susceptibility to sulphonation. After discussing the various possible groupings that can be sulphonated under the given conditions, it is concluded that they must be of the type of benzyl alcohol and (or) benzyl ethers. The behaviours of such groups in model substances subjected to lignin sulphonation conditions are then reviewed to elucidate the more specific nature of groups X, Z, B, and B^1. The X group most likely is the aliphatic hydroxyl in *p*-hydroxylbenzyl ether or alcohol and the Z group is the OH in a "sterically unhindered" *p*-alkoxybenzyl alcohol configuration. The B^1 group has properties similar to the configuration of the β-guaiacyl ether of veratrylglycerol, which type of structure should represent a large part of the sulphonatable groups in lignin.

Kleinert, Th., *Monatsh.* 80, No. 4: 582–584 (1949); cf. *B.I.P.C.* 19: 776; 20: 177 (1949).

When waste sulphite liquor is heated for 3 hr. with an excess of lime at 150°C., about 70% of the organic matter is precipitated and 80% of the organically combined sulphur is split off. Keeping the moist (50% water content) precipitate for several days in a closed bottle in the presence of air causes the formation of formaldehyde. The same is observed with a calcium ligninsulphonate prepared by means of the quinoline salt. No appreciable amount of acetaldehyde or vanillin can be detected. The latter is formed, however, when the dried precipitate is exposed to the action of the air.

Kratzl, K., *Monatsh.* 80, No. 3: 437–438 (1949); *B.I.P.C.* 19: 776–777; 20: 178 (1949).

The di- and tribromoacetaldehyde and the dibromoacetaldehyde diethylacetal formerly found on bromination of ligninsulphonic acid and its model substances have been found to result from the reaction of the bromine with a small amount of ether present during the bromination. With the complete exclusion of ether, no brominated acetaldehyde derivatives are found. The other results of the bromination experiments are not affected by this finding.

Analysis Committee, *Svensk Papperstidn.* 53, No. 1: 13 (Jan. 15, 1950); cf. *B.I.P.C.* 20: 514; 20: 478 (1950).

The text of Swedish Standard CCA22 is given, covering the method of analysis and the calculation.

Analysis Committee, *Svensk Papperstidn.* 52, No. 23: 597–598 (Dec. 15, 1949); cf. *B.I.P.C.* 20: 390; 20: 478 (1950).

The text of the Swedish Standard CCA20 is given, covering the apparatus, reagents (formaldehyde, barium chloride, hydrochloric acid, and sodium carbonate), withdrawal of sample, testing procedure, and calculations involved in the method.

Schwabe, K., *Monatsh.* 81, No. 4: 609–612 (June 15, 1950); *B.I.P.C.* 20: 908 (1950).

A short report is given on the electrolytic chlorination of waste sulphite liquor. The ligninsulphonic acid exerts a strong depolarizing action with platinum or graphite electrodes in acid, neutral, or alkaline solutions. Likewise, the sodium salt of propioguaiacone-α-sulphonic acid produces a depolarizing effect. Hypochlorite formation did not occur even at a high current density, because the chlorine reacted immediately with the waste sulphite liquor solids. Waste

sulphite liquor treated with ammonium carbonate to remove the calcium was chlorinated in a diaphragm cell with graphite anodes. When the electrolysis was carried out in alkaline solution (*N* potassium hydroxide, 2 *N* potassium chloride), a water-insoluble fraction (5.1% chlorine, 6.4% sulphur, and 10.4% methoxyl) and a water-soluble fraction (28.5% chlorine, 7.3% sulphur, and 4.88% methoxyl) were obtained. Evidently, a part of the chlorine taken up by the waste sulphite liquor solids was split off by the alkali. Storing the chlorinated product also resulted in a loss of chlorine. Electrolysis in hydrochloric acid solution followed by distillation of the anode solution resulted in 1 to 2% (based on waste sulphite liquor solids) of acetaldehyde as well as chloro- and dichloroacetaldehyde. The chlorinated product isolated from the distillation residue contained 11.3% chlorine, 9.41% sulphur, and only 1.78% methoxyl. The distillation residue also contained a small amount of an acid having a melting point of 96°C. and an equivalent weight of 61.7, which are the approximate values for glutaric acid.

FREUDENBERG, K., SIEBERT, W., HEIMBERGER, W., and KRAFT, R., *Chem. Ber.* 83, No. 6: 533–538 (1950); *B.I.P.C.* 21: 243 (1950).

The infrared absorption spectra of coniferyl alcohol, coniferyl aldehyde, native spruce lignin (Brauns), DHP, ammonium spruce lignin-sulphonate, ammonium DHP-sulphonate, methylated DHP, methylated spruce lignin isolated with formic acid-acetyl chloride, ammonium DHP-sulphonate treated with formic acid-acetyl chloride, and of dihydrodehydrodiisoeugenol methyl ether have been determined with films prepared by dropping solutions of equal concentrations in 80% dioxane on hot salt plates. The significance of the curves is discussed in detail. The spectra of DHP, ammonium DHP-sulphonate, and methylated DHP show striking resemblance with the corresponding spruce lignin preparations. These results support the concept that lignin is formed by dehydrogenation of coniferyl alcohol, followed by polymerization of the manifold diradicals and quinonemethides formed.

BENISTON, Q. P., AGAR, H. D., and MCCARTHY, J. L., *Anal. Chem.* 23, No. 7: 994–999 (July, 1951); *B.I.P.C.* 22: 334 (1952).

An ionophoretic procedure is described which provides a method for the analysis and characterization of mixtures of low-molecular weight ionic substances of similar chemical behavior. The ionic components of a sample mixture are made to migrate from an initial short sample section through an agar gel in a long straight tube under constant electrical potential gradient so that distances migrated are proportional to net mobilities. Under favorable conditions approximately complete separation of the components is achieved which permits a quantitative determination of the individual solutes and characterization by measurement of absorption spectra and diffusion constants. The method requires relatively inexpensive apparatus, limited expenditure of time, and very small quantities of material (as little as 10 micrograms). It has been applied to mixtures of dialyzable ligninsulphonic acids and to mixtures of guaiacol, acetovanillone, vanillin, and vanillic acid. Quantitative determination of these phenols to within 5% accuracy has been found possible by the integration of optical density patterns together with a knowledge of appropriate extinction coefficients and of the calibration of migration tubes.

LINDGREN, B. O., and SAEDEN, U., *Svensk Papperstidn.* 54: 785–798 (1951); cf. *B.I.P.C.* 22: 19–20, 22: 408 (1952).

Creighton, Gibbs, and Hibbert (cf. *B.I.P.C.* 14: 169) have shown that the lignins from gymnosperms, dicotyledons, and monocotyledons differ from one another. Lignin from gymnosperms is built up from phenylpropane monomers which, as a rule, have one methoxyl group, lignin from dicotyledons of monomers with both one and two methoxyl groups and lignin from monocotyledons of monomers with no, one, or two methoxyl groups. To establish any difference among these three types of lignins with regard to their content of A groups (cf. *B.I.P.C.* 22: 19) and their rate of delignification, the authors studied the action of acid and neutral sulphite solutions at 135°C. on a typical dicotyledon, birch (*Betula verrucosa* Ehrh.), and a typical monocotyledon, *Cana guadua* (*Guada angustifolia* Kunth), a grass from Ecuador which is closely related to bamboo. The experiments were carried out in the same manner as the previous ones with spruce lignin. The results show that the major portion of the lignin from Ecuador grass is dissolved rapidly by neutral sulphite solutions, so that it differs in this respect from the lignins of birch and spruce. A comparison of the delignification of birch and spruce shows that the two processes are very similar; it may therefore be assumed that the lignin of birch is bound by the same type of benzyl etherlike linkages which were postulated for spruce. The lignin from birch, like that from other dicotyledons, cannot be sulphonated to the same extent as spruce lignin by means of neutral sulphite solutions and, consequently, it appears that the lignins of dicotyledons have a lower content of A-groups than spruce, lignin.

EDHBORG, A., ERDTMAN, H., and LEOPOLD, B., *Acta Chem. Scand.* 6: 450–451 (1952); cf. *B.I.P.C.* 22: 668, 747 (1952).

A preliminary communication is presented in which experiments are described concerning the desulphonation of ligninsulphonic acid by aqueous alkali. The ligninsulphonic acid used was further sulphonated with sulphite containing S^{35}. A plot of the rate of reaction shows that two reactions are involved, one relatively fast and the other slow. In the rapid reaction about 30% of the total sulphur is liberated. The decrease in the specific activity of the liberated sulphur dioxide with time shows that the sulphur introduced in the second phase of sulphonation was more readily removed.

LAUTSCH, W., BROSER, W., ROTHKEGEL, W., BIEDERMANN, W., DOERING, U., and ZOSCHKE, H., *J. Polymer Sci.* 8, No. 2: 191–213 (Feb., 1952); cf. *B.I.P.C.* 16: 449; 22: 747 (1952).

In a discussion of the synthesis and properties of permutoids with ionic active groups, the development of ion-exchanging permutoids based on lignin is reviewed.

SENJU, R., *Bull. Chem. Soc. Japan* 25, No. 2: 131 (April, 1952); *B.I.P.C.* 22: 901 (1952).

Ligninsulphonic acid in waste sulphite liquor is quantitatively precipitated with polyglycolglucosamine. The determination is carried out by the addition of a standardized polyglycolglucosamine solution to a dilute waste sulphite liquor and the excess polyglycolglucosamine is titrated with a standardized polyvinyl alcohol sulphuric acid ester. It is claimed that ligninsulphonic acid and polyglycolglucosamine give a compound with a clear stoichiometric ratio of the components, from which an equivalent weight of about 380 is calculated for ligninsulphonic acid.

GILBERT, E. E., and JONES, E. P., *Ind. Eng. Chem.* 44, No. 9: 2082–2100 (Sept., 1952); *B.I.P.C.* 23: 128 (1952).

This review on the production of sulphonates during recent years includes a section on ligninsulphonates.

AULIN-ERDTMAN, G., *Svensk Papperstidn.* 55: 745–749 (1952); cf. *B.I.P.C.* 14: 319, 23: 254 (1952).

Extensive ultraviolet absorption studies have been carried out on various soluble derivatives of spruce lignin, Brauns' native lignin from *Picea mariana* and *Tsuga heterophylla*, the dehydrogenation-polymerization product (DHP) of coniferyl alcohol of Freudenberg, and low-molecular model substances; the purpose was the estimation of the content of

phenolic hydroxyl groups in softwood lignins and the disclosure of the origin of the long-wave absorption "shoulder" in the curves of various lignin preparations, as well as other structural features of lignin. The different model substances and preparations were investigated in various solvents which resulted in various degrees of ionization. In some cases the spectral changes caused by such reactions as sulphonation, methylation, and catalytic hydrogenation were studied. The data obtained for the model substances were used to calculate the changes in absorption which are to be expected upon the ionization of high-molecular compounds or mixtures containing various amounts of free phenolic hydroxyl groups. By comparing the experimental results for lignin and ligninlike preparations with computed values, certain conclusions were reached regarding the content of free phenolic hydroxyl groups in these substances. A table summarizes the results relating to nonconjugated guaiacyl nuclei with free phenolic hydroxyl groups. In addition, a low percentage (about 5% for Brauns' native lignin and less for ordinary preparations) of nonetherified diguaiacyl units of the tetrahydrodehydrodieugenol type is strongly indicated. No sterically hindered groups were found in any of the preparations. The spectral changes resulting from hydrogenation, sulphonation and methylation of the lignin substances and the DHP are consistent with the assumption that small amounts of etherified ferulic aldehyde elements are present in these products.

MAGNESIUM-BASE PROCESS

Whitney, R. P., Elias, R. M., and May, M. N., *Tappi* 34: 9 6–400 (1951); *C.A.* 46: 255 (1952).

Equilibrium constants have been calculated for the reactions normally expected in the combustion of Ca and Mg-base sulphite liquors. The data are used to show that recovery of Mg base as MgO is much easier than recovery of Ca as CaO.

Hull, Wm. Q., Baker, R. E., and Rogers, C. E., *Ind. Eng. Chem.* 43: 2424–2435 (1951); *Tappi* 35, No. 1: 22A, 24A, 26A, 28A, 32A, 34A, 38A, 40A, 42A, 48A, 50A, 52A (1952); *C.A.* 46: 2294 (1952).

The operation of the magnesium-base sulphite process at the Weyerhaeuser Longview mill is described and illustrated with flow diagrams. The mill is currently producing 300 to 325 tons of unbleached pulp per day. The consumption of MgO is 50 lb. and of S 85 lb. per ton of pulp produced. This high consumption of chemicals is considered due to the fact that the recovery system was designed for a daily production of only 275 tons. With sufficient evaporator capacity, which is presently being installed, the MgO consumption is expected to drop to 20 lb. and S consumption to 50 lb.; steam generation is expected to increase to 9000 lb. of steam at 615 p.s.i. and 725°F. per ton of pulp.

Hazelquist, S. E., U. S. pat. 2,572,929 (Oct. 30, 1951); *C.A.* 46: 4232 (1952).

The preparation of $Mg(HSO_3)_2$ liquor, by the addition of waste-liquor furnace gases containing 1% SO_2 to an aqueous slurry of MgO, is improved by the preliminary addition of SO_2 to maintain a pH of 4.0 to 4.5 and to prevent the formation of insoluble $MgSO_3$.

Stewart, T. W., U. S. pat. 2,596,875 (May 13, 1952); *C.A.* 46: 7330 (1952).

Waste sulphite liquor from the Mg-base cooking process is drawn from the last stage of a multiple-effect evaporator at 13 to 30 p.s.i.g. pressure and is stored in a tank at the same pressure. The use of this pressure storage tank eliminates the need for preheaters, and the concentrated waste sulphite liquor is fed directly to the recovery furnace; cf. *C.A.* 37: 6459.

Wilcoxson, L. S., *Proc. 6th Ind. Waste Conf.*, Purdue Univ., *Eng. Bull.*, Extension Ser. No. 76: 51–56 (1951); *C.A.* 46: 11679 (1952).

The chemical loss and stream pollution involved in the dumping of wastes from the $CaHSO_3$ method of digesting wood chips led to the substitution of $MgHSO_3$ as the base for the cooking acid. The process includes digestion of wood chips with the magnesium-base acid, separation of pulp, and reclamation of waste liquor from the cooking process, neutralization of the residual liquor with recovered MgO, concentration and burning of neutralized residual liquor, recovery of sulphur from gaseous products of combustion recovery of MgO as inorganic ash from combustion, and preparation of cooking acid from recycled chemicals.

Baker, R. E., and Wilcoxson, L. S., *Tappi* 33, No. 4: 187 90 (April, 1950); *B.I.P.C.* 20: 668 (1950).

This progress report on the magnesia-base sulphite pulping process is divided into a discussion of the five main steps of the cycle: acid making, cooking, washing, evaporation, and burning. Losses are indicated, and it is expected that further progress will be made to minimize them to increase the efficiency of the process.

Hazelquist, S. E., and Rogers, C. E., *Pulp and Paper* 24, No. 7: 39, 102, 104, 107–108 (June, 1950); cf. *B.I.P.C.* 20: 668; 20: 817 (1950).

Brief reference is made to three operational changes in the Weyerhaeuser magnesium-base sulphite recovery system at Longview, which have been incorporated since the presentation of previous papers on this subject. During a 9-day period in March, an intensive survey was conducted covering the operation of the recovery system, at which time the plant operated at a rate equivalent to 322 air-dry tons of unbleached, unscreened, unknotted pulp (permanganate number 13 by TAPPI standards) per day. Over this period it was necessary to add 39 lb. of magnesia and 93.7 lb. of sulphur as make-up per ton of pulp; 2100 lb. of total solids per ton were available at the furnace. An estimate of a feasible balance is presented which is economically attainable by minor changes in the present system; a brief outline of these changes is given Under optimum conditions at Longview, the make-up of sulphur could thereby be reduced to 71 lb. (70% recovery) and that of magnesia to 18 lb. (88% recovery); 2350 lb. of total solids per ton would become available for firing at the furnace. These findings apply to the conditions and recovery equipment as they now exist in the Longview mill.

MISCELLANEOUS USES

Hare, J. H., and Baker, B. E., *Can. J. Technol.* 29: 332–336 (1951); *C.A.* 46: 679 (1952).

Waste sulphite liquor was used for recovering whey proteins by a method similar to that of Wallerstein, *et al.* (*C.A.* 38: 5041 (1944)) for recovering proteins with ligninsulphonic acid from wheat mashes after fermentation. The optimum pH was 2 to 3. On an equivalent basis sodium ligninsulphonate is considerably more effective than $PhSO_3Na$, Na 1,2-naphthoquinone-4-sulphonate, and Na anthraquinone-β-sulphonate. Attempts to isolate the whey proteins from the lignosulphonate complex were unsuccessful. Preliminary rat-feeding tests indicated that the lignin-protein complex could be well tolerated when it supplied 10% of crude protein in the diet.

Witzmann, H., *Australian* pat. 172,661 (Oct. 10, 1952); *C.A.* 46: 11682 (1952).

Waste sulphite liquors are treated with alcohol or aqueous solutions of aromatic amines, e.g., benzidine, *p*-phenylenediamine, or *p*-toluenediamine; from the resulting solutions, lignin amino compounds are separated out at temperatures from 40 to 105° by acidifying with inorganic acids, e.g., H_2SO_4 or HCl, in the form of deeply colored Schiff bases. All other

ompounds besides lignin contained in the sulphite liquor emain unaltered.

Wahlin, B. G., U. S. pat. 2,481,959 (Sept. 13, 1949); *B.I.P.C.* 20: 149 (1949).

A method is given for preparing a foamy mass of waste sulphite liquor and a fibrous material suspended in water. The fibrous suspension containing the waste liquor is passed through a conduit provided with a foaming section having air inlets and means for imparting a rotating or whirling motion to the suspension; at the same time, air is sucked in through the inlets, and the suspension leaves the conduit as a foamy mass. The material is suitable for the manufacture of highly porous fibreboards or similar products.

Booth, R. B., and Pickens, R. A., U. S. pat. 2,485,083 (Oct. 18, 1949); *B.I.P.C.* 20: 215 (1949).

A method is given for reducing the copper sulphide minerals content in the tailing from froth flotation; an aqueous pulp of the ore is formed, the pulp is subjected to flotation in the presence of a promoter (xanthate, dithiophosphoric acid, or dithiophosphate type) and 0.01 to 0.5 lb. per ton of feed of a surface-modifying agent (an alkali or earth metal ligninsulphonate) for the copper sulphide minerals, and the resultant froth concentrate is recovered.

Graenacher, C., and Matter, M., U. S. pat. 2,490,958 (Dec. 13, 1949); *B.I.P.C.* 20: 692 (1950).

Five parts of ammonium sulphate are mixed with 7 parts of waste sulphite liquor powder to form a homogeneous mixture, which is then finely ground. The resulting powder is mixed with 84 parts of cupric oxychloride and 4 parts of kaolin, and very finely ground. Twenty parts of the resultant fine green powder are dispersed in 1000 parts of water, with the addition of 1.7 parts of dimethylolurea (m.p. 110–114°C.). A spraying liquid is obtained which is suitable for the treatment of fruit trees before bud swelling to protect the trees against fungus pests.

Hough, B. K., and Smith, J. C., *Paper Trade J.* 133: 40 (1951); *Ind. Labs.* 3: 73 (1952); *Chem. Eng. News* 30: 74, 75 (1952); *B.I.P.C.* 22: 359 (1952).

A process for utilizing waste sulphite liquor as a soil solidification agent is described. The addition of 3 to 10% of concentrated waste liquor and much smaller quantities of sodium or potassium bichromate imparts considerable cohesive strength to soils and makes them almost impervious to water. Laboratory and field tests have shown the process to have promise for stabilization of highway subgrades, production of synthetic aggregate by soil briquetting, and stabilization of loose, dry beach sand by penetration methods.

Nilsson, G., *Kgl. Lantbruks Högskol. Ann.* 17: 1–5 (1950); *B.I.P.C.* 22: 529 (1952).

Lignin, as well as tannin, is capable of forming complex compounds with various kinds of proteins. The possibility of utilizing the lignin in waste sulphite liquor, draff (the solution remaining after fermentation of the sugar in waste sulphite liquor and removal of the alcohol by distillation), and the alkali lignin prepared from sulphate black liquor was investigated for the precipitation of the protein from whey. It was found that 5 to 7% waste liquor or draff or a corresponding quantity of lignin precipitates the protein of whey completely at a pH of 3.5 to 4.5; heating of the whey to 30°C. facilitates the separation of the precipitate. Waste sulphite liquor produced a disagreeable taste and smell in the filtrate, whereas the other two did not. The precipitate of all three media could be used as a source of nitrogen for the culture of lactic acid bacteria and *Torula lactosa* equally as well as the whey before precipitation.

Hull, R. O., and Gray, A. G., Can. pat. 485,632 (Aug. 12, 1952); *B.I.P.C.* 23: 75 (1952).

A copper plating bath containing 250 grams of copper sulphate pentahydrate and 75 grams of sulphuric acid (66° Bé.) per liter is treated with from 0.1 to 5 grams of benzoquinone and 0.5 to 10 grams of waste sulphite liquor (on a dry basis) per liter (0.02 to 1 gram of an antifoaming agent—e.g., decanol or oleic acid—is also added); the copper deposits from such a bath are smooth and free from nodules, hard, and of improved wear resistance. The addition agents are stable, requiring only the addition of about 1.3 grams per liter each month for continued satisfactory operation.

Plump, R. E., and Carroll, J. W., Can. pat. 486,583 (Sept. 16, 1952); *B.I.P.C.* 23: 223 (1952).

An inhibitor for a pickling bath is formed by the addition of 89 parts of waste sulphite liquor and 89 parts of 37% formaldehyde to a solution of 60 parts of urea and 6 parts of thiourea in 89 parts of water; addition of 1.5 parts of hydrochloric acid causes the separation of the inhibitor. From 0.025 to 0.1% of this inhibitor is used in a pickling bath of 6% hydrochloric or 10% sulphuric or hydrofluoric acids.

POLLUTION STUDIES

Eldridge, E. F., and Orlob, G. T., *Sewage and Ind. Wastes* 23: 782–795 (1951); *C.A.* 46: 1194 (1952).

A pollutional barrier due to the discharge of wastes by two pulp mills and sewage from the city of Everett exists in the estuary of the south branch of the Snohomish River. This has caused large kills of fish and has adversely affected river frontage on the river and bay areas.

Van Horn, W. M., *Trans. Wisconsin Acad. Sci.* 39: 105–113 (1947–49); *C.A.* 46: 7328 (1952).

The work of various organizations interested in stream pollution and the disposal of waste liquors is reviewed, and the disposal of wastes from chemical pulping and other processes is discussed. In the Howard process, acid waste sulphite liquor solids are fractionally precipitated with lime yielding materials suitable for use in plastics and the manufacture of vanillin. Wastes can also be used as road binders, in coal briquets, in alcohol production, as fuel, for manufacture of fodder yeast, recovery of ethyl vanillate, as a food preservative, and in the manufacture of adhesives, ceramic materials, insecticides, soaps, fertilizers, etc. Alkaline pulping produces waste liquors which yield mercaptans, sulphides, turpentine, MeOH, sulphate soap, and tall oil. Other types of waste and methods of treatment are discussed briefly.

Schmidt, E., *Das Papier* 6: 222–224 (1952); *C.A.* 46: 10620 (1952).

Because of the heterogeneous mixture of substances in waste liquor, each of which may show a different reaction mechanism when treated with $KMnO_4$, any attempt to use $KMnO_4$ in determining organic matter with a view toward calculating the B.O.D. within 5 days is considered unsatisfactory.

Nothlich, F., *Gesundh.-Ing.* 68: 170 (1947); *Dept. Sci. Ind. Research Water Pollution Research, Summary Current Lit.* 21, No. 8: 188–189 (1948); *B.I.P.C.* 20: 350 (1950).

The author describes investigations on the composition and on the effect, in the presence and absence of domestic sewage, of filtered and unfiltered waste waters from the manufacture of chemical pulp, especially waste sulphite liquor, on the process of self-purification in river and sea water. The results are given of determinations of the effect of waste waters from the manufacture of pulp by the sulphite process, unfiltered and after filtration through soil, on the content of dissolved oxygen absorbed by permanganate, and the contents of combined, free, and aggressive carbon dioxide in waters of different salinities. The results showed that both

filtered and unfiltered waste waters increased the oxygen demand of water to which they were added and decreased its capacity for self-purification. Flocculation and sedimentation of suspended matter were greater the higher the salinity of the water and were also affected by the presence of domestic sewage, by filtration of the waste waters through soil, and by the initial content of the dissolved oxygen in the water. The effect of deposits of sludge on the oxygen demand of the water of a stream, especially at times of low flow, are discussed.

Tyler, R. G., *Trend in Engineering* 2: 4–9 (1950); *B.I.P.C.* 20: 431 (1950).

With particular reference to the water-pollution problems affecting the fishing industries in the State of Washington, the author discusses the results of several experiments for the safe disposal of waste sulphite liquor in various sections of the country. The part played by the Engineering Experiment Station and the Sanitary Engineering Laboratory of the University of Washington in studying water-pollution problems is mentioned.

Washington State Pollution Control Commission, *Sewage Ind. Wastes* 22, No. 4: 514–520 (April, 1950); *B.I.P.C.* 20: 667 (1950).

The requirements established by the Commission cover fundamental procedures for in-plant prevention and reduction of industrial waste discharges for a number of industries, including saw mills, veneer mills, and other wood handling, and pulp and paper mills, exclusive of waste sulphite liquor, which will be handled as a separate item. Fiber loss from beater and machine operations must be reduced to 1% of production and bark and knotty rejects be kept entirely out of the state waters, according to these requirements.

Rudolfs, W., and others, *Sewage Ind. Wastes* 22, No. 5: 593–653 (May, 1950); cf. *B.I.P.C.* 19: 659; 20: 746 (1950).

The pertinent literature for 1949 is reviewed. A special section of industrial wastes covers paper wastes (including white water, sulphite, digestion, deinking, sludge-dewatering, and semichemical wastes), pp. 622–625; the final section on water pollution (abatement and control, biology and bacteriology, chemistry, stream standards, and oxygen sag and self-purification), pp. 635–640, should also be of interest to the pulp and paper industry.

Murdock, H. R., *Ind. Eng. Chem.* 42, No. 6: 71–2A (June, 1946); *B.I.P.C.* 20: 817 (1950).

The author discusses the effects which mandatory orders for the reduction of stream pollution by State authorities in Wisconsin and Washington are exerting upon the sulphite industry. Present efforts for abatement are reviewed, as well as the problems which make the economic disposal of sulphite waste liquor so difficult, notably the large quantities of water to be evaporated and the corrosiveness of the liquor. Biological disposal methods did not prove encouraging. If the industry is forced to reduce production to the natural ability of the receiving streams to handle the waste sulphite liquor, it is doomed. A substitution of the kraft process may be one solution.

Crown Zellerbach Corp., *Chem. Eng.* 58: 246, 248 (1951); *B.I.P.C.* 22: 284 (1951).

The Crown-Willamette Div. of Crown Zellerbach Corp. is building a 19-acre settling basin adjacent to its West Linn, Ore., plant which will have a capacity of 88 million gal. of waste liquor. The waste sulphite liquor will be held there until the level of the Willamette River is sufficiently high that the waste will not lower the oxygen content to an extent that would be harmful to fish life.

Anon., *Paper Ind.* 33: 1162, 1164, 1167 (1952); cf. *B.I.P.C.* 22: 360; 22: 438 (1952).

The different research projects of the Sulphite Pulp Manufacturers' Research League in Wisconsin mills, United States Health Service acts, and legislation for controlling water pollution in other states are reviewed briefly.

Murdock, H. R., *Ind. Eng. Chem.* 44, No. 3: 507–513 (March, 1952); *B.I.P.C.* 22: 613 (1952).

The author reviews the recent legislation concerning stream pollution and some of the latest developments in the removal of suspended solvents, treatment of deinking waste, treatment of waste kraft liquors, and disposal methods for waste sulphite liquor, including references to salable products and heat and chemical recovery.

Rudolfs, W., and Hanalon, W. D., *Ind. Eng. Chem.* 44, No. 3: 531–533 (March, 1952); *B.I.P.C.* 22: 613 (1952).

The color characteristics of industrial wastes depend on the light source, the degree of transmittance or reflectance by the wastes, and the color sensitivity of the observer. Light transmittance properties may be represented by transmittance curves or expressed as "dominant wavelength," "luminance," and "purity." Paper mill wastes have nonselective light transmittance curves. The color intensity of rope, rag, and sulphite cooking liquor decreases with decreasing pH values, and hard water salts affect a color reduction with rag and rope cooking liquors. Aerobic and anaerobic biologic treatment increase the color intensity of rag cooking liquors and board mill white water but decrease the color intensity of jute cooking liquor wastes; aerobic treatment also increases the color intensity of sulphite cooking liquor.

Rudolfs, W., and others, *Sewage Ind. Wastes* 24, No. 5: 541–641 (May, 1952); cf. *B.I.P.C.* 21: 732; 22: 774 (1952).

A section of this extensive review deals with pulp and paper wastes (pp. 582–584). Reference is also made to the pollutional effect of pulp mill effluents in the section on water pollution (p. 623).

Mendlina, N. G., *Zhur. Priklad. Khim.* (*J. Applied Chem.*) 24: 640–646 (1951); *C.A.* 46: 733 (1952).

Hydrolytic lignin, obtained by treatment of cellulosic matter with dilute mineral acids under pressure at high temperature, is almost completely insoluble and has few OH groups. Treatment with sulphites, bisulphites, free H_2SO_3, or chlorination does not yield soluble products. Treatment with 10% oleum gives about 50% soluble matter which, upon treatment with $CaCO_3$, displays tanning properties. Treatment of the lignin with PhOH (6 to 12 hr. at 100°) gives a condensation product that is insoluble in H_2O, but subsequent sulphonation, as above, gives a completely soluble product suitable for tanning and of somewhat better quality than cellulose-sulphite extracts. The sulphonation is best done with 200% oleum (with respect to product, by weight) for 5 hr. at 25 to 80°.

Mauthe, G., and Noerr, H., Can. pat. 464,023 (March 28, 1950); *B.I.P.C.* 20: 621 (1950).

Thirty-five parts of caustic soda (35° Bé.) are mixed with 188 parts of purified waste sulphite liquor (35° Bé.) and heated to 100°C. in about 1.5 hr. To this mixture there are added 25 parts of a resin prepared from 400 parts of phenol, 100 parts of grape sugar, and 20 parts of hydrochloric acid; the resin is added at about 60°C., with agitation. Aqueous sulphuric acid is added until the pH of the mixture is about 3.5. After cooling, the mixture separates into two layers. In order to facilitate the separation of the solid layer which contains the major portion of the tanning material, 20 parts of ammonium sulphate are added. The resultant product can be diluted with water and used for tanning leather, preferably at a pH of 3.5 to 4.5. This is the same as U. S. pat. 2,184,622, which was issued Dec. 26, 1939.

Plapper, J., *Colloquiumsber. Inst. Gerbereichem. Tech. Hochschule Darmstadt* No. 5: 60–79 (1949); *B.I.P.C.* 20: 718 (1950).

The author reviews the structure and sulphonation of lignin and tannin and discusses the use of ligninsulphonates as tanning materials.

Vagner, J., *Colloquiumsber. Inst. Gerbereichem. Tech. Hochschule Darmstadt* No. 5: 80–90 (1949); *B.I.P.C.* 20: 747 (1950).

The author reviews the work of Masner, Samec, and Bevsky on tanning with pure lignin extracts and with combinations of lignin extracts and quebracho. Most of the data were originally published in Collegium.

Williams, K. T., and Potter, E. F., U. S. pat. 2,505,818 May 2, 1950); B.I.P.C. 20: 767 (1950).

Western hemlock bark is extracted with hot water, and the resulting extract is evaporated to about 15% total solids. It is found that about 15%, or perhaps as much as 50% of the total solids present in the resulting concentrated extract is insoluble at this concentration. Waste sulphite liquor is modified by treatment with sodium hydroxide to raise the pH to approximately 5; the calcium ions are almost completely replaced with sodium ions by the addition of sodium oxalate. The concentrated extract is mixed with the modified waste liquor in such proportions that 75% of the total dissolved material present in the resulting mixture will come from the extract and 25% will come from the modified waste liquor. The mixture is heated to about 180°F. for about 3 hr. and then evaporated to about 15% total solids. The evaporated mixture contains less than 1% of insoluble material. The product is suitable for use in tanning hides.

Naum, M., Lovin, R., and Salvesen, J. R., *J. Am. Leather Chemists Assoc.* 47, No. 4: 269–278; discussion 278–280 (April, 1952); *B.I.P.C.* 22: 695 (1952).

Laboratory investigations which were carried out to establish the mechanism of tanning with ligninsulphonates prepared by fractional precipitation from waste sulphite liquor show that the sulphonic groups in ligninsulphonates combine with the protein in the hide. The degree of sulphonation, the molecular weight of the ligninsulphonates, and the pH determine the amount and firmness with which they combine. Under normal tanning conditions, at a pH of 3 to 4.5, a 25 to 30° tannage is obtainable with fractionated ligninsulphonates. With ligninsulphonates from untreated waste sulphite liquor a degree of tannage of 12 to 17 is obtained. The procedures for using ligninsulphonates to the best advantage were also determined, and it was found that larger amounts of ligninsulphonates can be used if applied as a pretan, followed by a vegetable retan. This method produces a leather with normal physical properties. Chrome-tanned leather can be retanned with ligninsulphonates either alone or in combination.

REVIEW ARTICLES

Erdtman, H., *Svensk Kem. Tid.* 63: 43–66 (1951); *C.A.* 46: 407 (1952).

Review of the 1945–50 accomplishments of Swedish organic chemical research, with reference to forest products, lignin and the sulphite process, herbicides, quinones, and sugars.

Majrich, A., *Chemie* (*Prague*) 5: 3–5 (1949); *C.A.* 46: 1172 (1952).

Majrich describes attempts to use the lignin substances for the preparation of vanillin, hydrated phenols, resins, tanning agents, permutoids, adhesives, sizing substances, and highway materials. The fermentable substances lead to the production of EtOH.

Marshall, H. B., *Pulp Paper Mag. Can.* 53, No. 5: 125–37 (1952); cf. *C.A.* 45: 4447 (1951); 46: 6381 (1952).

A bibliography of the literature on the utilization of waste sulphite liquor for 1951.

Marshall, H. B., and Johnson, A. M., *Tappi* 35, No. 1: 146–180A (1952); *C.A.* 46: 6829 (1952).

A bibliography of the literature on the utilization of waste sulphite liquor from July, 1943 to December, 1950.

Glanzer, P., *Can. Pulp Paper Ind.* 3, No. 1: 21, 30–34 (Jan., 1950); *B.I.P.C.* 20: 432 (1950).

The author reviews recent developments in the utilization of waste sulphite liquor; brief reference is also made to tall oil and turpentine as by-products of the sulphate industry.

R.L.D., *Ind. Eng. Chem.* 42, No. 3: 10A, 12A, 16A (Advertisement section) (March, 1950); *B.I.P.C.* 20: 567 (1950).

The problems connected with the profitable utilization of lignin from waste sulphite liquor, accomplishments to date, and recent literature on the subject are reviewed briefly.

Salvesen, J. R., *Pulp and Paper* 24, No. 6: 68, 70 (May, 1950); *B.I.P.C.* 20: 747 (1950).

The author reviews and appraises various proposed solutions of the waste sulphite liquor disposal problem, including Marathon developments (vanillin, boiler compounds, dispersing, and surface-active agents, all with rather limited market possibilities), tanning agents, alcohol, yeast and evaporation and burning for energy, with particular reference to the Rosenblad channel-switching system.

U.S. Forest Products Laboratory, *Wood* 56, No. 11: 54 (1951); *B.I.P.C.* 22: 254 (1951).

The present small-scale uses and proposed uses for lignin include: an additive to the negative plates of storage batteries to improve their efficiency at low temperatures, to portland cement to improve its flow properties, and to plastics and plastic laminates; an extender for rubber; an adhesive for linoleum; a binder for sand and on roads; an antiscaling agent for boilers; a tanning agent; a raw material for the chemical production of vanillin and hydrogenation products; a fuel; and a soil conditioner.

Bjorkman, A., *Svensk Papperstidn.* 54, No. 22: 757–763 (Nov. 30, 1951); *B.I.P.C.* 22: 407 (1952).

The report covers a 9-month period, six of which were spent at The Institute of Paper Chemistry and three in traveling to various mills and research laboratories. Reference is made to studies and developments of vanillin, hydrogenation of lignin, lignin plastics, the use of lignin in rubber in place of carbon black and of lignin sulphonic acid as a tanning agent, an additive for cement and concrete, and a dispersing agent, etc. In addition, the activities of the Sulphite Pulp Manufacturers' Research League in Wisconsin, magnesium and ammonium-base sulphite cooking, the manufacture of sulphite alcohol and yeast, lagooning of waste sulphite liquor and pipe-line systems for carrying it beyond points where it can cause harmful pollution, applications of cymene and conidendrin, the wood-saccharification plant at Springfield, Ore., and studies of the fundamental chemistry of lignin in various research laboratories of the United States and Canada are discussed.

Chene, M., and Deissenberg, Ch., *Papeterie* 73, No. 11: 621, 623, 625, 627, 629; No. 12: 682–683, 685, 687, 689, 691 (1951); *B.I.P.C.* 22: 497 (1952).

The authors review the principal possibilities for the profitable utilization of lignin from waste sulphite liquor, black (sulphate or soda) liquors, and wood saccharification, as well as of lignin in wood.

LYBERG, B., *Svensk Papperstidn.* 55, No. 11: 385–392 (June 15, 1952); *B.I.P.C.* 22: 902 (1952).

The possibilities of developing a Swedish chemical industry based upon the by-products of the forest industries, ethyl alcohol from waste sulphite liquor in particular, are discussed.

ANON, *Paper Trade J.* 135, No. 2: 14, 16, 18 (July 11, 1952); *Tappi* 35, No. 8: 87–90A (Aug., 1952); *B.I.P.C.* 22, 947 (1952).

Essentially the same information is presented as in the following abstract.

ANON., *Can. Chem. Processing* 36, No. 7: 36–38 (June 20, 1952); *Pulp Paper Mag. Can.* 53, No. 9: 84–85 (Aug., 1952); cf. *B.I.P.C.* 18: 123; 20: 559; 22: 947 (1952).

The development of Lignosol, a product derived from waste sulphite liquor, is outlined. The first pilot plant was built in Chandler, Que., in 1943 and used until 1951; then construction of a new enlarged plant in Quebec City was started and completed in the late spring of 1952. In 1950, Lignosol Chemicals Ltd. was formed to operate the entire project; the company is financed jointly by the Anglo Newfoundland Development Co. Ltd. and the Anglo Canadian Pulp and Paper Mills Ltd. The different Lignosol products developed to date are listed: they include road, foundry-core, and refractory binders; adhesives; dispersing, tanning, dye-leveling, and soil-stabilizing agents; additives in electrolytic copper refining, and others.

ANON., *Modern Ind.* 24, No. 2: 109–110 (Aug., 1952); *B.I.P.C.* 23: 51 (1952).

Some of the lignin chemicals which the Marathon Corp. produces from waste sulphite liquor and their possible applications are reviewed.

G.C.I., *Ind. Eng. Chem.* 44, No. 8: 17–18A (Aug., 1952); *B.I.P.C.* 23: 52 (1952).

The most persistent problem facing the sulphite pulp industry is the treatment or utilization of its waste liquor; a technology of both has been developed, but neither one is economically satisfactory. Present research on the whole liquor, the sugar fraction, the lignin fraction, and the recovery of pulping chemicals, with particular reference to the work by the Sulphite Pulp Manufacturers' Research League, is reviewed briefly.

ANNETT, S. R. P., *Can. Chem. Processing* 36, No. 11: 84, 86 (Oct., 1952); *B.I.P.C.* 23: 205 (1952).

The author discusses established uses of Lignosol (cf. *B.I.P.C.* 22: 947) and the search for new applications by the company which produces it.

ANON., *Can. Chem. Processing* 36, No. 11: 14, 16–17 (Oct., 1952); *B.I.P.C.* 23: 205 (1952).

The Canadian sulphite pulp production in 1951 amounted to 2,533,000 tons with about equal quantities of waste. A brief review of the utilization of the waste sulphite liquor by several Canadian mills is given, including fodder yeast, ethyl alcohol, vanillin, powdered ligninsulphonate, and lignosol products.

ADLER, E., and LINDGREN, B. O., *Svensk Papperstidn.* 55: 563–575 (1952); *B.I.P.C.* 23: 253 (1952).

The authors summarize studies on the structure of lignin carried out at the Swedish Forest Products Research Laboratory within the last decade and discuss the results in relation to both older findings and recent work published by other investigators.

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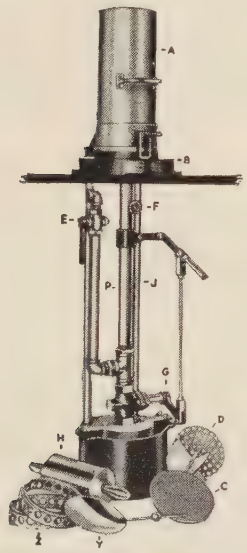

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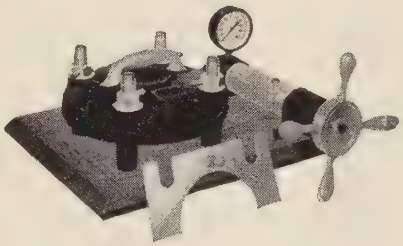

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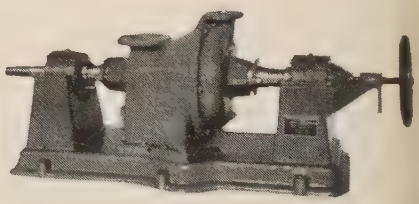

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CLASSIFICATION OF AMMONIA-BASE PULPING LITERATURE

D. E. HELLEUR

A comprehensive condensed classification of the ammonia-base pulping literature (1900 to June, 1953) is presented. Some 85 articles and 47 U. S. patents are classified from various points of view, having in mind the interests of both the mill and the laboratory.

AMMONIA-base pulping is not new. The first patent was issued to Braun in 1902 (*34, 69, 100*). In recent years, not only has it been receiving increasing attention and interest but it has also been used fairly extensively to produce commercial tonnages of pulp. The major part of this use and interest has centered around the ammonium bisulphite process.

To aid those who are interested in the literature of this particular field, references have been collected and classified for the period 1900 to June, 1953. In classifying these references, an attempt has been made to anticipate the interests of both the operational and technical approaches to the subject. No attempt has been made to review the material critically. Reference numbers below 100 are for technical papers and those above 100 are for patents.

APPLICATION TO SPECIFIC FIBROUS MATERIALS

Woods

Some of these studies were directed to certain wood species generally considered difficult to pulp with calcium bisulphite liquors. For example, in the case of Douglas-fir, chips were pretreated with ammonium hydroxide to extract resinous materials, then ammonium bisulphite liquor was added to cook the wood (*10*). Studies on Douglas-fir without pretreatment include (*11*), (*18*), and (*58*).

Specific wood species used to study the process varies include: white fir (*36*); aspen, in attempt to yield a purified pulp for chemical conversion (*70*); longleaf pine, using an extraction with liquid sulphur dioxide followed by the ammonium bisulphite process (*57*); pine and beech (*65*); mixed hardwoods (birch, maple, beech) using the ammonia neutral sulphite and the bisulphite processes, with base comparisons (*77*); Bordeaux pine (*15*).

Agricultural Residues

Short study using ammonium sulphite neutral process on straw (*15*); bisulphite on straw (*7*) with base comparisons; use of ammonium hydroxide on various materials (corn, oats, and straw stalks) (*8, 62, 102, 119*).

COOKING PROCESSES

Ammonium Hydroxide

König Process. Wood is heated with ammonium hydroxide and this treatment is followed by treatment with a mineral acid (or vice versa) (*101*); a further patent with the emphasis on by-product recovery was (*102*). Disadvantages of this process are discussed in (*31*) and general comments given in (*30, 31*).

Gluteor. The principle of the process lies in the saponification of casein to obtain a product which under certain conditions of pressure and temperature evolves nascent ammonia which can be used for cooking fibrous materials. Merits and demerits are discussed in (*8, 29*).

Billwiller. A broad patented process making use of such cooking chemicals as ammonia, sodium carbonate, hydrogen sulphide, etc., with the emphasis on the use of catalysts and of a pretreatment using these chemicals followed by known cooking processes (i.e., prior to 1919) (*108*). For the use of ammonium hydroxide specifically, see (*111*). Discussion of: merits (*12*) and general process (*6*).

Other Processes. Pulping agricultural residues (*119*). See also (II, IV, V, VI) under miscellaneous cooking processes.

Pretreatments with ammonium hydroxide (*116*) plus preferably some ammonium sulphite (*120*) to remove resinous materials (*118*) followed by the ammonium bisulphite process (*10, 121, 140*); or followed by sulphuric acid (*50*). See also (X) under miscellaneous.

Ammonium Sulphite (Neutral and Alkaline)

The first patent by Braun (*100*) described a more or less neutral sulphite pulping process. Comments on this process (*25*). Another patent is (*105*). A later patent tended to the more alkaline side (*34, 104*). One tending to the acid is (*106*). Pulping of straw and wood (*15*). Reviews covering this type (as well as those in the acid range) are (*34, 68, 73*). Its use in semichemical pulping (*48*).

See also (I, III, IV, VI) under miscellaneous.

Ammonium Bisulphite (Excess Sulphurous Acid)

Cross (and Englestad) Process. Using low combined sulphur dioxide (0.5 to 0.25%) (*109, 110*); laboratory studies on this process are (*22*), and general reports (*28, 76*); references made to it in the studies of Dorée and Hall (*26, 27*).

Others are (*106, 112, 117, 118, 121, 122, 125, 129,*

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131, *134*, *140*, *141*, *142*, *143*, and *146*). See also (I, IV, VI, IX, X, XIII) under miscellaneous.

Using a liquid sulphur dioxide pretreatment (on longleaf pine) followed by the bisulphite (*57*). Comments on this study (*65*); others (*7*, *10*, *11*, *20*, *35*, *38*). General reviews covering the process are (*17*, *34*, *38*, *85*).

Miscellaneous Cooking Processes

(I) *Gaseous Cooking.* Sammet and Merrill treat fibrous materials with gaseous ammonia and sulphur dioxide and steam (*103*); a gaseous pretreatment laboratory trial (*16*).

(II) Using ammonia and steam only, there are (*76*, *139*).

(III) A somewhat novel way of arriving at an ammonium sulphite cooking liquor is to treat a calcium bisulphite solution with ammonia, thus forming an ammonium sulphite solution with the precipitation of calcium sulphite. The fibrous material is then cooked with this ammonium sulphite liquor (*104*).

(IV) A very broad patent covering a wide pH range, and using such chemicals as ammonia, sulphur dioxide, steam (separately or together) is (*107*).

(V) On processes using a solution of cyanide or cyanate which forms ammonia by saponification with water; supposedly, the difficulties in the decomposition of wood by ammonium hydroxide are thereby avoided (*115*).

(VI) Another very broad patent covers pulping with ammonia and sulphur dioxide as well as the sulphite, sulphate, carbonate, and sulphide salts of ammonium either separately or in combination; for certain wood the ammonium bisulphite is preferred; for materials like cotton linters, ammonia; agricultural residues, slightly alkaline ammonium sulphite; a "kraft" cook also can be used, e.g., 2% ammonia and 2% ammonium sulphide; etc. (*123*).

(VII) To avoid the high cost of ammonia, Richter advocates cooking with 1 to 8% ammonium sulphate and 3 to 8% free sulphur dioxide (*117*).

(VIII) Processes cooking with mixtures of other bases (e.g., NaOH, Na_2S, Na acetate, etc.) together with ammonia are (*124*, *126*).

(IX) To cook with a high percentage of sulphur dioxide (5 to 26%) an aqueous solution of ethyl alcohol was employed, to which was also added 0.7% ammonia (*60*).

(X) Another process pretreats with excess liquid ammonia, the excess being removed to be followed by a solution of sulphurous acid, such that in effect the final cooking is done by the usual bisulphite process (*131*).

(XI) Another suggests cooking with ammonium sulphate with the addition of organic nitrogen compounds—e.g., aniline, triethanolamine, etc. (*135*).

(XII) Another in the same vein suggests using ammonium hydroxide together with mixtures of soaps, oils, fats, alkalies, sodium sibeate, potassium chloride, etc. (*136*).

(XIII) A process re-using spent liquors after fortification with cooking chemicals is (*144*).

SPENT LIQUORS—UTILIZATION

Recovery in General

A general discussion of the recovery of bisulphite bases including ammonia (*63*); an industrial review of the sulphite (acid) process including evaporation of liquors (ammonium included) (*79*); comparison of the various sulphite pulping methods from the point of view of the spent liquors (*71*).

Evaporation

Under pressure to recover chemicals (*130*, *133*). An allied subject is concentration by recycling (*144*).

Evaporating and Burning (Recovery of Heat)

Included with a cooking process in heat recovery step (*144*, *146*); commercial trials are reported (*14*, *33*, *46*, *61*, *81*).

Recovery of Cooking Chemicals

Ammonia. Distillation with a base (*127*, *128*, *132*, *133*), with lime as the base (*127*, *128*), with kraft black liquor (*21*, *132*), with magnesium oxide as the base (*146*), by pyrolysis (*53*, *71*, *137*), by ion exchange (deashing) (*52*), by steam stripping (*52*), and by vacuum evaporation (*52*).

Sulphur Dioxide. Commercial trials, sulphur dioxide liberated during the burning step (*14*, *61*, *81*); recovered during evaporation (*130*, *133*).

Ammonia and Sulphur Dioxide. Processes claiming to recover both: Solvay process (*71*, *133*); by boiling under pressure at approximate 40% concentration (*137*); by boiling to liberate sulphur dioxide, then addition of a base to liberate ammonia (*133*); by a process of pyrolysis on the concentrated solution or the dry solids (*138*); pertinent to this latter process is (*53*); treating with magnesia to liberate ammonia and to convert liquor to magnesium base, evaporating and burning the converted liquor to yield magnesia for reuse and sulphur dioxide, which is recovered from the combustion gases using the liberated ammonia (*146*).

Other Liquor Utilization

Fertilizers—(*5*, *55*). A general discussion of producing ammonia for fertilizers from wood waste is (*66*); liquor neutralized with basic calcium phosphate rock, etc., evaporated and dried (*114*); as an organic *cation exchanger* (*145*); *stabilizer* in bituminous emulsions (*143*); *re-using* the spent liquor in cooking operations after fortification with cooking chemicals (*144*); *fermentation* to ethanol (*1*).

Miscellaneous uses of the spent liquor are adhesives, wetting agents, dispersants, soil conditioner, yeast nutrient, etc. One such product is sold under the trademark Orzan (*23*, *55*).

A process purports to produce decomposition products by neutralizing the liquor with ammonia, and heating with carbon to yield acetic, formic, and oxalic acids and activated carbon (*113*).

MILLS AND OPERATIONS

Literature references to mills that are using or have used ammonium-base processes either on full-scale operations or as short mill trials are listed below. Except for one in Norway, the mills listed are in the United States:

1. American Box Board Co., Filer City, Mich. (*48*).
2. Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., and Interlake Div., Appleton, Wis. (*2*, *46*, *48*).

Crown Zellerbach Corp., Lebanon mill (also pilot plant study of evaporation and burning the spent liquor) (*14, 51, 61, 81*).
4. Diamond Match Co., Ogdensburg mill (*37*).
5. Eastern Corp., Lincoln and South Brewer mills (*51*).
6. International Paper Co., Southern Kraft Div. (*48*).
7. Rayonier, Inc., Shelton, Wash. (*3, 5, 33, 51, 65*).
8. Toten Cellulosefabrik, Nygard (Norway) (*24, 35, 51, 75*).
9. Wausau Paper Mills Co., Brokaw, Wis. (*2, 82*).

Organization and implementation of an ammonia-base trial discussed (*34*). Design of ammonia-base sulphite acid systems (*42, 43, 44, 45, 54, 82, 83*). Preparation of raw cooking acid (*13*). Digester linings (*78*). Corrosion of linings (*40*). Review of the field and a report of the progress (*48, 49, 65, 72, 75*).

ANALYSIS, TESTING, AND GENERAL CHEMISTRY

Testing of the cooking liquor with a modified Palmrose method (*13*). Conductometric analysis of the pulping liquors for such as ammonium hydroxide, carbonate, sulphite, bisulphite, and acetate (*84*).

Sulphite process (*22, 26, 27, 32, 36, 56, 58*). Chemistry of reactions, cooking variables, etc., kinetics of, penetration studies (*16, 19, 36, 39*); ammonia pretreatment (*16, 59*); system: ammonia, sulphur dioxide, and water (*42, 43, 44, 45*); cooking liquor (*56*); spent liquor (*27, 32*).

ADVANTAGES CLAIMED FOR AMMONIA-BASE PULPING

Claims and comparisons together with their references are listed below. Many of these claims, it will be noted, are not specific to ammonia-base but exist only when taken in comparison with some other base. Practically all the claims are made with respect to the ammonium bisulphite process.

1. Ease of raw material handling (i.e., cooking chemicals) (*4, 37*).
2. Amenable to the pulping of difficult woods (*9, 10, 11, 18, 58*).
3. Superior quality of raw acid (*4, 37, 54*).
4. Superior condition of the digester equipment (*4*).
5. Cooking variables (*4, 58, 77*); superior penetration (*9, 19, 74, 81*); lower cooking temperatures (*24, 35, 67, 72, 81*); reduced cooking time (*28, 37, 67*).
6. Higher pulp yields (i.e., lower screenings) (*4, 9, 17, 22, 24, 35, 37, 51, 58, 67, 72, 74, 77, 81*).
7. Superior pulps qualities, high alpha-cellulose (*10, 11*); stronger pulp (*4, 9, 38, 41, 51, 74, 81*).
8. Lower bleach requirements (*4*).
9. Plant maintenance less (*51, 81*).
10. Recovery of heat and chemicals (*14, 24, 35*); and all of section "Spent Liquors—Utilization."

GENERAL REVIEWS

General reviews (mainly bibliographic in nature) have been incorporated in the above. For ready reference, they are (*34, 37, 68, 75, 79, 85*).

LITERATURE CITED

References to the *Bulletin* (*Library Notes*) of The Institute of Paper Chemistry (*B.I.P.C.*) and *Chemical Abstracts* (*C. A.*) are included in all cases where the abstract gives a summary of the article in question.

1. Agar, Hilda, P., and McCarthy, Joseph, Sulphite waste liquor. I. Fermentation of ethanol of conc. Ca, Mg, and NH_4 sulphite waste liquor. *Tappi* 34, No. 3: 126–131 (March, 1951); *B.I.P.C.* 21: 584; *C.A.* 45: 4447.
2. Ammonia in more mills; liquor burning at Badger and Interlake. *Pulp & Paper* 25, No. 3: 64 (March, 1951); *B.I.P.C.* 21: 585.
3. Ammonia pulping report. *Paper Ind.* 33, No. 12: 1438–1439 (March, 1952); *B.I.P.C.* 22: 614.
4. Aries, Robert S., Recent developments in the utilization of sulphite waste liquors. *Northeastern Wood Utilization Council Bull.* No. 14: 97–121 (Jan., 1947); *B.I.P.C.* 17: 380.
5. Aries, Robert S., Research on lignin as a soil builder. *Northeastern Wood Utilization Council Bull.* No. 7: 56–62 (Oct., 1945); *C.A.* 40: 1623; *B.I.P.C.* 16: 183.
6. Arnot, J. Melrose, Some new processes for the separation of fibrous cellulose from plant substances. *World's Paper Trade Rev.* 95, No. 11: 961–962, 964 (March 13, 1931); *B.I.P.C.* 1, No. 9: 20.
7. Aronovsky, S. I., Ernst, A. J., Sutcliffe, H. M., and Nelson, G. H., Agricultural residue pulps—comparison of pulping processes. *Tech. Assoc. Papers* 31: 299–304 (June, 1948); *Paper Trade J.* 126, No. 26: 78–83 (June 24, 1948); *C.A.* 42: 5662; *B.A.* 1948B, II: 387; *B.I.P.C.* 18: 790.
8. Barbier, Emile, Imitation kraft paper from straw by means of the so-called Gluteor process. *Papeterie* 49, No. 12: 538–543 (June 25, 1927); *T.S.* 86: 7; *C.A.* 21: 2984.
9. Benson, Henry, K., Ammonia pulping of wood. *Pulp & Paper* 24, No. 8: 74, 76 (July, 1950); *B.I.P.C.* 20: 907.
10. Benson, H. K., Erwin, R. P., Hendrickson, J. R., and Tershin, J. A., The pulping of Douglas-fir by ammonia-base liquor. *Paper Trade J.* 99, No. 12: 87–89 (Sept. 20, 1934); *Tech. Assoc. Papers*, 18: 513–515; discussion, 486–487 (June, 1935); *C.A.* 28: 7522; *T.S.* 99: 322; *B.I.P.C.* 5: 46.
11. Benson, H. K., and Lucas, J. E., The pulping of Douglas-fir with ammonium bisulphite. *Paper Trade J.* 111, No. 7: 32–34 (Aug. 15, 1940); *C.A.* 34: 8265; *B.C.P.A.* 1940B: 786; *B.I.P.C.* 11: 35.
12. Billwiller cooking process. *Zellstoff u. Papier* 11, No. 4: 197 (April, 1931); *T.S.* 94: 3.
13. Bishop, F. F., and Honstead, J. F., Ammonia-base sulphite pulping liquors—their preparation and analysis. *Tappi* 34, No. 7: 318–323 (July, 1951); *C.A.* 46: 255; *B.A.* 1951B, II: 1009; *B.I.P.C.* 21: 877.
14. Booth, Kenneth, G., Ammonia sulphite process. *Pulp & Paper* 26, No. 9: 80, 82, 84 (Aug., 1952); *B.I.P.C.* 23: 754.
15. Brot, M. V., and Hirschel, M., Treatment of straw and of resinous woods with sodium sulphite and ammonium sulphite. *Papier* 29, No. 1: 75–80 (Jan., 1926); *Paper Ind.* 8, No. 1: 97, 99, 101 (April, 1926); *T.S.* 83: 100; *C.A.* 20: 1322.
16. Bryde, O., The significance of penetration in the sulphite cook; the possibility for improving penetration by artificial means. *Norsk Skogind.* 3, No. 7: 169–172 (July, 1949); *B.I.P.C.* 20: 192.
17. Cable, Donald, E., Sulphite pulp from spruce. *Paper Trade J.* 85, No. 13: 43–49; No. 14: 58–63; No. 15: 50–55 (Sept, 29, Oct. 6, 13, 1927); *Pulp Paper Mag. Canada* 25, No. 39: 1215–1222; No. 41: 1299–1305; No. 42: 1331–1332; No. 44: 1405–1408, 1422, 1424 (Sept. 29, Oct. 13, 20, Nov. 3, 1927); *Zellstoff u. Papier* 8, No. 6: 372–373 (June, 1928); *T.S.* 87: 28; *C.A.* 22: 1681.
18. Chidester, G. H., and McGovern, J. N., Sulphite pulp from Douglas-fir. *Paper Trade J.* 113, No. 9: 34–38 (Aug. 28, 1941); *Tech. Assoc. Papers* 24: 226–230 (June, 1941); *Paper Ind.* 28, No. 3: 288 (June, 1941); *B.I.P.C.* 12: 57.
19. Christensen, G. N., and Williams, E. J., Diffusion in Wood: III. Ion selection and its effect on the diffusion of electrolytes. *Australian J. Applied Sci.* 2: 440–453 (1951).
20. Colter, John, S., Use of recovered ammonia in sulphite pulping. *Paper Trade J.* 136, No. 23: 13 (June 5, 1953).
21. Cooper, Stuart, R., Ammonia recovery from sulphite waste liquor. *Paper Trade J.* 136, No. 23: 13 (June 5, 1953).
22. Cross, C. F., and Engelstad, A., The action of aqueous sulphurous acid on lignocellulose. II. *J. Soc. Chem. Ind.* 44, No. 23: 267–270 (June 5, 1925); *Paper Trade J.* 81, No. 8: 45–48 (Aug. 20, 1925); *T.S.* 82: 8; *C.A.* 19: 2742.
23. Crown Zellerbach Corp. Add waste utilization. *Chem. Week* 70, No. 15: 34 (April 12, 1952); *Chem. Eng.* 59, No. 5: 230–231 (May, 1952); *B.I.P.C.* 22: 696.
24. Dahl, Jacob, More about Norway's sulphite mill which cooks with ammonia base. *Pulp Paper Ind.* 20, No. 2: 65 (Feb., 1946); *B.I.P.C.* 16: 369.
25. Dieckmann, Richard "Sulfitzellstoff," page 213, Ottono, Elsner, Berlin Pub.
26. Dorée, Charles, and Barton-Wright, Eustace, C., The lignosulphonic acid obtained from sprucewood by the action of sulphurous acid in the presence of ammonia. *J. Soc. Chem. Ind.* 48, No. 2: 9–12T (Jan. 11, 1929); *C.A.* 23: 1885; *B.C.A.* 1929B: 166.

27. Dorée, Charles, and Hall, Leslie, The lignosulphonic acid obtained from sprucewood by the action of sulphurous acid in the presence of ammonia. *J. Soc. Chem. Ind.* 44, No. 23: 270–274T (June 5, 1925); *C.A.* 19: 2742.
28. Engelstad, Alfred, the Cross and Engelstad process for cooking cellulose with sulphurous acid solution in the presence of ammonia. *Papir J.* 19, No. 5: 58–60, No. 6: 67–69 (March 31, April 15, 1931); *C.A.* 26: 4711.
29. Fournier, Raymond, Imitation kraft by the so-called Gluteor process. *Papeterie* 50, No. 4: 170, 173–174 (Feb. 25, 1928); *T.S.* 87: 238.
30. Frank, - -, Quality of the cellulose prepared by the König process. *Papier-Ztg.* 39, No. 17: 571 (Feb. 26, 1914); *Wochbl. Papierfabr.* 45, No. 13: 1118–1121 (March 28, 1914); *C.A.* 8: 1502.
31. Froberg, A., König's new process for the manufacture of cellulose. *Wochbl. Papierfabr.* 44, No. 47: 4432–4434 (Nov. 22, 1913); *J. Soc. Chem. Ind.* 32: 1152; *C.A.* 8: 2802.
32. Hägglund, Erik, Chemistry of sulphite cooking. *Svensk Kem Tid.* 38, No. 7: 177–192 (July, 1926); *Papier-Fabr.* 24, No. 30: 449–450; No. 32: 483–488 (July 25, Aug. 8, 1926); *C.A.* 20: 3807; *T.S.* 84: 189; *B.C.A.* 1926B: 312, 911.
33. Hatch, Raymond, S., Comparison of possible bases for sulphite pulping—economics of recovery. *Pulp Paper Ind.* 21, No. 4: 42, 44, 46, 48 (April, 1947); *Pulp Paper Mag. Canada* 47, No. 9: 80–84 (Aug. 1946); *C.A.* 40: 6812; *B.A.* 1946B, II: 456, 1948B, II: 24; *B.I.P.C.* 17: 153.
34. Hausen, J., Alkalies as bases for sulphite liquor. *Papier-Fabr.* 24, No. 45: 691–695; No. 46: 709–713; No. 47: 722–728 (Nov. 7–21, 1926); *Paper Trade J.* 84, No. 9: 51–60 (March 3, 1927); *Tech. Assoc. Papers* 10, No. 1: 130–139 (June, 1927); *Paper Ind.* 8, No. 11: 1914a–1914h, 1917 (Feb., 1927); *C.A.* 21: 1350; *T.S.* 85: 171.
35. Hazelquist, Svarre E., Innovations in Sweden and Norway. *Pulp Paper Ind.* 20, No. 13: 58 (Dec., 1946); *B.I.P.C.* 17: 245.
36. Hepher, W. S., and Jahn, E. C., Action of ammonium sulphite on white fir. *Paper Trade J.* 95, No. 19: 33–38 (Nov. 10, 1932); *C.A.* 27: 1748; *T.S.* 96: 25; *B.I.P.C.* 3: 98.
37. Horton, J. L., Organization and implementation of an ammonia-base mill trial. *Pulp Paper Mag. Can.* 54, No. 3: 205–209, 214 (Convention, 1953); *B.I.P.C.* 23, No. 8: 584.
38. Houghton, E. O., Ammonium bisulphite—its use as a base in the sulphite process. *Pulp Paper Mag. Canada* 35, No. 2: 97–101 (Feb., 1934); *T.S.* 99: 23; *C.A.* 28: 2896; *B.C.A.* 1934B: 316; *B.I.P.C.* 4: 167.
39. Howell, Charles, M., and Cunningham, Eugene, L., Effect of chip dimensions on penetration of ammonia-base cook-acid. *Paper Trade J.* 136, No. 23: 14 (June 5, 1953).
40. Huseby, R. A., and Scheil, M. A., Corrosion and corrosion testing in the pulp and paper industry. *Tappi* 33, No. 3: 138–148 (March, 1950); *B.I.P.C.* 21: 693.
41. Jennes, L. C., and Nystrom, G. L., Sulphite semichemical pulping of chip screenings. *Tech. Assoc. Papers* 31: 443–445 (June, 1948); *Paper Trade J.* 126, No. 24: 53–55 (June 10, 1948); *C.A.* 42: 5665; *B.A.* 1948B, I: 389, 470; *B.I.P.C.* 18: 793.
42. Johnstone, H. F., Recovery of sulphur dioxide from dilute gases. *Pulp Paper Mag. Can.* 53, No. 4: 104–112 (March, 1952); *Paper Trade J.* 134, No. 21: 24, 26, 32, 36, 39 (May 23, 1952); *B.I.P.C.* 22: 696.
43. Johnstone, H. F., Recovery of sulphur dioxide from waste gases. *Ind. Eng. Chem.* 27: 587–593 (May, 1935).
44. Johnstone, H. F., and Keyes, D. B., Recovery of sulphur dioxide from waste gases. *Ind. Eng. Chem.* 27: 659–665 (June, 1935).
45. Johnstone, H. F., Read, H. J., and Blankmeyer, H. C., Recovery of sulphur dioxide from waste gases. *Ind. Eng. Chem.* 30: 101 (Jan., 1938).
46. Jolley, R. S., Burning of sulphite liquor. *Pulp & Paper* 26, No. 10: 98, 100, 102 (Sept., 1952); *B.I.P.C.* 23, No. 2: 128.
47. Jonas, K. G., and Walter, P., Sulphite cooking process. *Wochbl. Papierfabr.* 62, No. 23A: 55–58 (June 6, 1931); *B.I.P.C.* 1: 36.
48. Jones, R. M., and Detcher, T. E., Ammonia base in the neutral sulphite semichemical pulping process. *Tappi* 34, No. 8: 88A, 90A, 92A, (Aug., 1951); *B.I.P.C.* 22: 47.
49. Jones, R. M., and Detcher, T. E., Ammonium bisulphite pulping. *Paper Trade J.* 133, No. 5: 20, 22, 24, 26, 28 (Aug. 3, 1951); *Paper Mill News* 74, No. 36: 12–16 (Sept. 8, 1951); *Pulp Paper Mag. Canada* 52, No. 11:116–122 (Oct., 1951); *C.A.* 46: 734; *B.I.P.C.* 22: 54.
50. König, J., Hasenbäumer, J , and Braun, M., Manufacture of cellulose from wood and textile fibers and utilization of the waste liquor. *Z. angew. Chem.* 26: 484–485 (Sept. 12, 1913); *J. Soc. Chem. Ind.* 32: 939; *Paper* 13, No. 8: 21 (Nov. 5, 1913).
51. LaFond, L. A., and Holzer, W. F., Commercial sulphite production experience with ammonia-base acid. *Tappi* 34, No. 6:241–247 (June, 1951); *C.A.* 45: 8764; *B.A.* 1951 B, II: 887; *B.I.P.C.* 21: 806.
52. Markham, Aaron, E., and McCarthy, Joseph, L., Composition changes occurring during vacuum evaporation, steam stripping, and de-ashing of ammonium sulphite liquors. *Tech. Assoc. Papers* 31: 236–238 (June, 1948); *Paper Trade J.* 126, No. 25: 70–72 (June 17, 1948); *C.A.* 42: 5664; *B.A.* 1948B, II: 390, 535; *B.I.P.C.* 18: 792.
53. Markham, Aaron, E., Peniston, Quintin P., and McCarthy, Joseph, L., The pyrolysis of ammonium sulphite waste liquor to yield ammonia. *Tech. Assoc. Papers* 31: 407–411 (June, 1948); *Paper Trade J.* 127, No. 1: 64–68 (July 1, 1948); *C.A.* 42: 7040; *B.A.* 1948B, II: 390; *B.I.P.C.* 18: 871.
54. Marriner, D. E., and Whitney, Roy, P., The solubility of sulphur dioxide in ammonia-base sulphite cooking acid. *Paper Trade J.* 126, No. 21: 52–54 (May 20, 1948); *Tech. Assoc. Papers* 31: 143–145 (June, 1948); *C.A.* 42: 4748; *B.A.* 1948B, II: 390, 535; *B.I.P.C.* 18: 713. See also TAPPI data sheets 148C–148D (Dec., 1948).
55. Martin, J. B., Utilization of NH_3-base SO_3 liquor. *Tappi* 36, No. 6: 175–176A (June, 1953); Proc. 4th Ann. Pac. NW Ind. Waste Conference. Washington State Inst. of Tech., Washington State College.
56. Marusawa, Tsuneya, Constitution and stability of various liquors used in the sulphite process and their specification in the digestion process. *J. Soc. Chem. Ind. Japan* 20: 255–301, 737–773 (1917); *J. Soc. Chem, Ind.* 36: 868; 37: 52A; *C.A.* 11: 2405.
57. McKee, Ralph H., and Cable, Donald E., A liquid sulphur dioxide process for sulphite pulp. III. Character of pulp obtained from extracted longleaf pine chips. *Paper Trade J.* 80, No. 17: 41–46 (April 23, 1925); *C.A.* 19: 1947; *T.S.* 81: 136.
58. Mottet, Arthur L., The sulphonation of western hemlock lignin. *Pac. Pulp Paper Ind.* 13, No. 10: 22–25 (Oct., 1939); *B.I.P.C.* 10: 121.
59. Moulton, R. W., and Ziegler, J. G., Study of the effect of NH_3 pretreatment on pulping of resinous woods. U. of Washington thesis (1932).
60. Palmen, John, The cooking of spruce chips with sulphur dioxide solutions of high concentration. *Finnish Paper Timber J.* 6, No. 21: 612, 614–616; No. 24: 696, 698–700 (Nov. 15, Dec. 31, 1926); *Pulp Paper Mag. Canada* 25, No. 48: 1547–1551 (Sec. 1, 1927); *T.S.* 86: 339.
61. Palmrose, G. V., and Hull, J. H., Pilot plant recovery of heat and sulphur from spent ammonia-base sulphite pulping liquor. *Tappi* 35, No. 5: 193–198 (May, 1952); *B.I.P.C.* 22: 775.
62. Peterson, C. J., and Hixon, R. M., The use of ammonium hydroxide as a pulping agent for the grasses. *Icwa State Coll. J. Sci* 7, No. 1: 25–28 (Oct., 1932); *C.A.* 27: 1505.
63. Pullianen, Eino, Calcium, sodium, ammonium, and magnesium bisulphite cooking liquors and their recovery. *Finnish Paper Timber J.* 29, No. 16: 225–226, 228–229 (August 30, 1947); *B.I.P.C.* 18: 402.
64. Rayonier sulphite mill will reopen with new ammonia-base cooking system. *Pulp Paper Ind.* 19, No. 7: 21 (July, 1945).
65. Ress, Hans, The present technical position of the manufacture of sulphite pulp from pine and beech. *Zellstoff-u. Faser* 32, No. 7: 97–106 (July, 1932); *T.S.* 102: 169, *B.I.P.C.* 6: 157.
66. Risi, J., Ammonia fertilizers from wood waste. *Can. Chem. Process Inds.* 34, No. 12: 972–974 (Dec., 1950); *B.I.P.C.* 21: 357.
67. Robak, C. A., Ammonium sulphite cellulose cooking process makes headway. *Ind. Eng. Chem. News Ed.* 14, No. 9: 396 (Oct. 10, 1936); *B.I.P.C.* 7: 91.
68. Rue, John D., Soluble sulphites and their bisulphites in pulping of wood. A review of the literature. *Paper Trade J.* 81, No. 16: 54–56 (Oct. 15, 1925); *Tech. Assoc. Papers* 9, No. 1: 137–139 (1926); *T.S.* 82: 251.
69. Schubert, Max, "Die Cellulose Fabrikation," 3rd ed., Berlin, Fischer's Technologischer Verlag M. Krayn.
70. Simmonds, F. A., Kingsbury, R. M., Martin, J. S., and Keller, E. L., Purified hardwood pulps for chemical conversion. I. Aspen sulphite and prehydrolysis-sulphite pulps. *Tappi* 36, No. 3: 103–110 (March, 1953); *B.I.P.C.* 23, No. 8: 574.
71. Solvay Process Co., Comparison of various methods of sulphite pulping from the point of view of waste liquors. *Northeastern Wood Utilization Council Bull.* No. 7: 65–72 (Oct., 1945); *B.I.P.C.* 16: 211.
72. Stockman, Lennart, Cooking with ammonium bisulphite. *Svensk Papperstidn.* 56, No. 1: 11–14 (Jan. 15, 1953); *B.I.P.C.* 23, No. 7: 509.

73. Stops, Paul, A survey of some pulping methods. *Proc. Australian Pulp Paper Ind. Tech. Assoc.* 1: 154–165; discussion, 165–168 (Dec., 1948); *B.A.* 1948B, II: 606; *B.I.P.C.* 19: 12.
74. Sulphite mill cooks with ammonia base in Norway; another with soda base in Sweden. *Pulp Paper Ind.* 19, No. 10: 24 (Oct., 1945); *B.I.P.C.* 16: 165.
75. Sulphite pulp may offer postwar ammonia market. *Chem. Ind.* 55, No. 5: 818 (Nov., 1944); *B.I.P.C.* 18: 186.
76. Svenska Pappers- och Celluloseingeniörsföreningen. Pulping of wood with ammonium bisulphite according to Engelstad. *Tekniska Meddelanden* TB 2 (June, 1940), 1 page.
77. Thode, E. F., and Lee, Y. H., Ammonium-base sulphite pulping of hardwoods. *Tappi* 33, No. 6: 257–260 (June, 1950); *B.I.P.C.* 20: 816.
78. Tucker, E. F., Digester linings for soluble-base sulphite pulping. *Tappi* 33, No. 1: 29–32 (Jan., 1950); *B.I.P.C.* 20: 393.
79. Vincent, Rex., Position of the sulphite (acid) process in the chemical and paper fields (industrial review) and bibliography. Also evaporation of liquors; hardwoods. *Paper Trade J.* 122, No. 9: 136, 138, 140, 142; *T.S.* 93–96 (Feb. 28, 1946); *Tech. Assoc. Papers* 29: 202–205 (June, 1946); *Paper Mill News* 69, No. 9: 122, 124, 126–127 (March 2, 1946); *Pulp Paper Ind.* 20, No. 3: 50, 52 (March, 1946); *Papermaker* 111, No. 5: *T.S.* 54–56 (May, 1946); *C.A.* 40: 2299; *B.I.P.C.* 16: 370.
80. Waddell, R. D., Ammonia-base process—evaporating and burning at Lebanon. *Pulp & Paper* 25, No. 11: 58 (Oct. 1951); *B.I.P.C.* 22: 205.
81. Waddell, R. D., Ammonia-base sulphite mill. *Pulp & Paper* 25, No. 8: 56, 58 (July, 1951); *B.I.P.C.* 22: 205.
82. Wausau's new acid plant in full operation. *Paper Trade J.* 136, No. 23: 10 (June 5, 1953); *Paper Mill News* 72, No. 23: 6 (June 6, 1953); *Paper Ind.* 35, No. 4: 423–424 (July, 1953).
83. Whitney, Roy P., and Han, S. T., Design basis for ammonia-base sulphite raw-acid towers. *Tappi* 35, No. 12: 569–576 (Dec. 1952); *B.I.P.C.* 23: 309.
84. Whittemore, E. R., Dryden, E. C., and Aronovsky, S. I., Conductometric analysis of sodium sulphite and ammoniacal pulping liquors. *Paper Trade J.* 112, No. 25: 29–34 (June 19, 1941); *C.A.* 35: 6537; *B.C.P.A.* 1941B, II: 340; *B.I.P.C.* 11: 396.
85. Yorston, F. H., Use of ammonia in sulphite cooking. *Pulp Paper Res. Inst. Canada. Laboratory Rept.* No. 27 (1943–44).

atents

1902

00. Braun, Deutsches Republic pat. 151,285 (1902).

1912

01. König, J., Manufacture of a cattlefood, with simultaneous recovery of cellulose, resin, etc., from cellulose containing material. Ger. pat. 265,483 (Feb. 15, 1912); *J. Soc. Chem. Ind.* 32: 1063; *C.A.* 8: 386.
02. König, J., Fodder and cellulose. Ger. pat. 273,094 (June 14, 1912); *C.A.* 8: 2586.
03. Sammet, Charles, F., and Merrill, Jason L., Process for treating fiber-yielding materials. U. S. pat. 1,016,178 (Jan. 30, 1912); *C.A.* 6: 803.

1914

04. Brech, Leon, and Tyborowski, Edmund, Manufacture of cellulose from raw materials containing cellulose fiber U. S. pat. 1,100,519 (June 16, 1914); Can. pat. 145,860 (Feb. 11, 1913); Brit. pat. 5552 (March 6, 1911); Fr. pat. 438,130 (March 6, 1911); Ger. pat. 252,321 (Feb. 23, 1911) and 257, 544 (Dec. 17, 1911); *C.A.* 7: 549, 1609, 2473.
05. Harnist, Charles, Fr. pat. 156,777 (1914).

1917

06. Marusawa, Tsuneya, Process of manufacturing paper pulp. U. S. pat. 1,244,525 (Oct. 30, 1917); Jap. pat. 31,675 (Oct. 27, 1917); and 31,941 (Dec. 24, 1917); *C.A.* 12: 224, 1252, 2249.

1921

07. Harnist, Charles, Fibrous cellulose. Brit. pat. 156,777 (Jan. 7, 1921); Fr. pat. 477,895 (1915); addition pat. 24,034 and 24,174 (1922); Ger. pat. 469,373 (Aug. 9, 1920); *C.A.* 15: 1811; *T.S.* 81: 138, 247, 90: 355.

1922

08. Billwiller, John, and Billwiller, J., Manufacture of fibrous-containing substances. Brit. pat. 206,570 (Aug. 4, 1922); Ger. pat. 376,488 (Nov. 11, 1919); *T.S.* 77: 125; 79: 17; *J. Soc. Chem. Ind.* 43; B90; *C.A.* 18: 1199.

1923

09. Cross, Charles F., and Engelstad, Alfred, Wood pulp. Brit. pat. 229,002 (Nov. 15, 1923); Ger. pat. 495,146 (Oct. 23, 1924); Fr. pat. 588,071 (Oct. 25, 1924); *C.A.* 19: 3018; *T.S.* 82: 251.

1925

10. Cross, Charles, F., Manufacture of wood pulp and by-products. U. S. pat. 1,547,907 (July 28, 1925); *C.A.* 19: 3018; *T.S.* 82: 235.

1927

11. Billwiller, John, Method of loosening vegetable fibers. U. S. pat. 1,649,281 (Nov. 15, 1927); *T.S.* 87: 238; *C.A.* 22: 500.
12. Ekstrom, P. G., and Hult, R. H., Process for the manufacture of sulphite pulp from wood or other fibrous materials. Swed. pat. 68,741 (Sept. 26, 1927); *T.S.* 91: 275.

1929

13. Michael, Wilhelm, and Palm, Albert, Recovery of sulphite waste liquor for re-use. U. S. pat. 1,723,800 (Aug. 6, 1929); Can. pat. 283,415 (Sept. 18, 1929); *T.S.* 89: 92; 91: 207; 92: 31; *C.A.* 22: 4246.
14. Richter, George, A., Recovery of valuable products from spent sulphite liquors. U. S. pat. 1,710,272 (April 23, 1929); *T.S.* 90: 204; *C.A.* 23: 2780.
15. Sido, Otto, and Wiederhold, Hermann. Process for the production of cellulose. Ger. pat. 505,589 (Aug. 18, 1929); *T.S.* 93: 174; *C.A.* 25: 593.

1930

16. Baker, Webster E. B., Sulphite wood pulp and method of making the same. U. S. pat. 1,773,419 (Aug. 19, 1930); *C.A.* 24: 5158.
17. Richter, George A., Production of sulphite pulp. U. S. pat. 1,780,842 (Nov. 4, 1930); Can. pat. 283,024 (Sept. 4, 1928); *T.S.* 89: 81; 92: 292; *C.A.* 25: 206.

1931

18. Benson, Henry, K., Process for making sulphite pulp from Douglas-fir and other resinous conifers. U. S. pat. 1,805-799 (May 19, 1931); *C.A.* 25: 3825; *T.S.* 94: 126.
19. Hixon, Ralph M., Peterson, Charles J., and Werkman, Charles H., Process of pulping plant tissues by means of a volatile base. U. S. pat. 1,802,715 (April 28, 1931); *T.-S.* 94: 123; *C.A.* 25: 3836.
20. Richter, George A., Process for the production of chemical wood pulp. U. S. pat. 1,817,525 (Aug. 4, 1931); Can. pat. 309,867 (March 31, 1931); *T.S.* 93: 170; 94: 139; *C.A.* 25: 5560.

1932

21. Richardson, Roger W., Pulping process. U. S. pat. 1,885,-764 (Nov. 1, 1932); Can. pat. 335,222 (Aug. 29, 1933); *T.S.* 97: 233; 98: 198; *C.A.* 27: 5538.
22. Richardson, Roger W., and Sherman, Clarence S., Production of cellulose pulps. U. S. pat. 1,851,522 (March 29, 1932); Can. pat. 328,828 (Dec. 27, 1932); *T.S.* 95: 204; 97: 318; *C.A.* 26: 3112.
23. Seaman, Stewart E., Process of producing cellulose. U. S. pat. 1,891,337 (Dec. 20, 1932); Can. pat. 326,709 (Oct. 11, 1932); *T.S.* 97: 234, 295; *C.A.* 27: 2032.

1933

24. Bori, Antonio B., and Estape, José M., Process of preparing cellulose. U. S. pat. 1,920,239 (Aug. 1, 1933); *T.S.* 98: 232; *C.A.* 27: 4926.
25. Hahn, Frederick C., and Fothergill, Robert E., Manufacture of wood pulp. U. S. pat. 1,926,002 (Sept 5, 1933); *T.S.* 98: 198; *C.A.* 27: 5538.

1934

26. Estape, José M., Production of alpha-cellulose. Fr. pat. 759,690 (Feb. 7, 1934); *T.S.* 99: 332.
27. Richardson, Roger W., Recovery of ammonia from cook liquor. U. S. pat. 1,943,345 (Jan. 16, 1934); Can. pat. 353,924 (Nov. 5, 1935); *T.S.* 99: 164; 103: 248; *C.A.* 30: 1561.

1935

28. Brill, John L., Ammonia recovery. U. S. pat. 2,014,374 (Sept. 17, 1935); *C.A.* 29: 7597.
29. Kuwahata, Seiji, Pulp for rayon. Jap. pat. 11,240 (April 6, 1935); *C.A.* 29: 8330; *T.S.* 103: 70.

1936

30. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Recovery of sulphur dioxide and ammonia from sulphite waste liquors. Nor. pat. 59,627 (May 6, 1936); Swed. pat. 92,828 (Oct. 11, 1937); *C.A.* 33: 1938.

131. Richter, George A., Fiber-liberating process. U. S. pat. 2,032,437 (March 3, 1936); *C.A.* 30: 2759; *T.S.* 103: 248.
132. Richter, George A., Process of correlating chemical recovery in pulp mills operating with different kinds of liquors. U. S. pat. 2,047,032 (July 7, 1936); *C.A.* 30: 6197; *T.S.* 103: 354.

1937

133. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Recovery sulphur dioxide and ammonia from waste liquors. Nor. pat. 58,194 (July 19, 1937); *C.A.* 31: 8926.
134. Olsen, Fredrich, Cellulose pulping system and product thereof. U. S. pat. 2,087,263 (July 20, 1937); *C.A.* 31: 6464; *T.S.* 106: 130; *B.C.P.A.* 1940B: 199.
135. Saft, Juljusz, Cellulose. Fr. pat. 817,852 (Sept. 13, 1937); *C.A.* 32: 2351.

1938

136. Kovàts, Lajos, Pulp. Hung. pat. 119, 466 (Nov. 15, 1938); *C.A.* 33: 3149.
137. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Working up waste ammonium bisulphite liquors. Nor. pat. 59,229 (April 11, 1938); addition to 58,781 (Jan. 3, 1938); *C.A.* 32: 7264.
138. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Sulphite waste liquor treatment. Fr. pat. 823,778 (Jan. 26, 1938); *T.S.* 109: 62.
139. Waeser, Bruno, Pulping cellulosic material. Ger. pat. 658,686 (April 11, 1938); *C.A.* 32: 6462.

1939

140. Richter, George A., Cellulosic material pulping process. Can. pat. 382,892 (July 25, 1939).

1941

141. Olsen, Fredrich, Goff, Lionel, and Sheldon, Lyle M., Process of producing wood cellulose. U. S. pat. 2,230,119 (Jan. 28, 1941); *C.A.* 35: 3090.

1942

142. Sheldon, Lyle, M., Cellulose pulping system. U. S. pat. 2,300,733 (Nov. 3, 1942).

1950

143. Jesseph, Donald C., Stable bituminous emulsion and preparation thereof. U. S. pat. 2,494,708 (issued Jan. 17, 1950). 4 claims. *C.A.* 44: 3706; *B.I.P.C.* 20: 768.

1951

144. Parrett, Arthur, N., Wood pulp digestion. U. S. pat. 2,564,028. Filed Jan. 17, 1946. Issued Aug. 14, 1951 3 claims. Assigned to Rayonier, Inc., (Cl. 92–11); *B.I.P.C.* 22: 87.

1952

145. Andersen, Carl C., Treatment of waste sulphite liquor. Can. pat. 481,243. Filed Aug. 21, 1939. Issued Feb. 19, 1952. 2 claims. Assigned to Norsk Hydro-Elecktrisk Kvaelstofaktieselskab; *B.I.P.C.* 22: 643.
146. Helleur, Donald, Treatment of the spent cooking liquor of an ammonia-base sulphite pulping process. U. S. pat. 2,596,241. Filed Dec. 20, 1948. Issued May 13, 1952. 4 claims. Assigned to Price Brothers & Co., Ltd. (Cl. 23–129); *B.I.P.C.* 22: 799.

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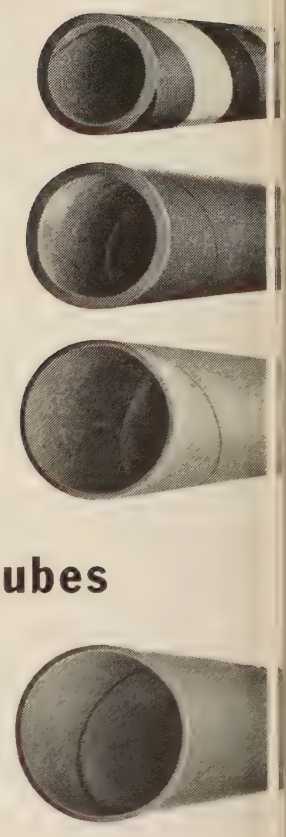

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Thirty-ninth Annual Meeting, Commodore Hotel, New York, N. Y., February 15–18, 1954.

Fifth Coating Conference, Poland Spring House, Poland Spring, Me., May 26–27, 1954.

Fundamental Research Conference on the Fundamentals of the Paper Machine, Appleton, Wis., September 21–24, 1954.

Ninth Engineering Conference, Philadelphia, Pa., October 18–21, 1954.

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ARCCO 1044-31 — Heat Seal Coating for Candy Bar Wraps. Data Sheet C-66.

ARCCO 716-6 — Heat Seal Spot Coating for Waxed Glassine. Data Sheet C-66.

FOILAC 1261-12C — (Clear) Solution Coatings for Metal Foils. Data Sheet C-61-R.

ARCCO 1044-27A — **ARCCO 1044-27B** — Heat Seal Greaseproof Resin Emulsion Coatings. Data Sheet A-43.

ARWAX 717-46B — Hot Melt — paraffin wax additive for improved heat seal and improved water-vapor resistance. Data Sheet C-71.

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